CHEMISTRY

JUN 30 1953

APRIL
1953

D.I.T.
726
.126
NO.8

50¢

Let the Analyst Beware

➤ "Now THAT you are studying chemistry, you can tell me what this is made of," chortles your friend, presenting a bottle of heavily perfumed, gooey liquid, or a nondescript white powder, or a mineral, or a piece of junk metal. Everybody knows that the man with the test-tube can analyze anything.

Analytical chemistry presents the challenge to solve a puzzle. It can be an interesting game. The inexperienced chemist will, however, be well advised to keep his extracurricular testing on that plane, until he knows his client's motives.

Analytical testing, like all other scientific work, presupposes a quest for truth, an honest wish to know the facts about the situation, on the part of the person who asks for the tests as well as on the part of the scientist who makes the tests. If the person who asks to have the tests made is interested merely in degrading the testing standards to get his product "by," the situation immediately becomes intolerable.

One important field for the analyst is in the protection of consumers' interests. In interpreting the results of such analysis the questions are: is the buyer getting his money's worth? and: should the seller misrepresent the goods he is selling in order to "make a fast buck"? Here somebody is sure to quote the dreary old Roman proverb: *Caveat emptor,* as though anything were to be gained by noting that cheating is not a novel art.

A generation has now grown up under the protection gained by two epic struggles against this form of dishonesty. The American Medical Association made notable gains against the cruel and fraudulent "cancer cures" of a generation ago. Dirty food-handling practices and dishonest substitution in packaged food and drugs were routed by the U. S. Department of Agriculture under Dr. Harvey W. Wiley in the administration of Theodore Roosevelt. It will not do for either the government, the consumer, or the business man of integrity to forget the lessons learned in those campaigns.

CHEMISTRY

Vol. 26, No. 8 — Formerly The Chemistry Leaflet — April 1953

Including The Science Leaflet

Published monthly, September through May, by Science Service, Inc., the non-profit institution for the popularization of science. Publication Office: 119 South Frazier St., State College, Pa. Entered as second-class matter at the Post Office, State College, Pa., under Act of Congress of March 3, 1879. Address subscriptions and editorial communications to the Editorial Office: 1719 N Street N.W., Washington 6, D. C.

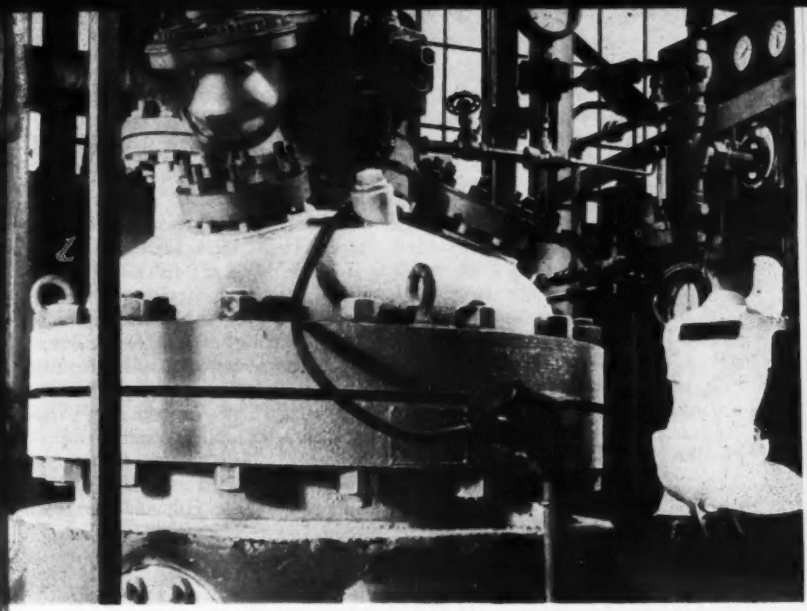
$4 a Year; Two-Year Subscription $7; Your Own and a Gift Subscription $7 a Year. 50c a Copy. Ten or more subscriptions to the same address: $2.90 a Year each. Subscriptions preferred for full volumes only, September through May inclusive; back copies sent. No charge for Foreign or Canadian Postage.

Editors: WATSON DAVIS and HELEN MILES DAVIS

Consulting Editor: PAULINE BEERY MACK (Editor 1927-1944)

Copyright 1953 by Science Service, Inc. All rights reserved. Science Service issues press service for newspapers and magazines, publishes Science News Letter (weekly), issues THINGS *of Science* (monthly) and administers Science Clubs of America.

Science Service is the educational and scientific institution organized in 1921 as a non-profit corporation with trustees nominated by the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, the E. W. Scripps Estate and the Journalistic Profession.



—Photo courtesy Firestone News Service

➤ FROSTY *reaction vats show that the term "cold rubber" is no figure of speech. Here 120 gallons of refrigerated chemicals are mixed to form GR-S by the new process, in the RFC-owned, Firestone- operated plant in Akron.*

Cold Rubber Is Leading

by A. C. MONAHAN

➤ IN THE SYNTHETIC rubber field, more "cold" rubber is now being produced than older types which might, by way of contrast, be called "hot" rubbers. The terms cold and hot refer merely to the temperatures employed in processing. Cold rubber is produced at a temperature only a few degrees above the freezing point of water. The older synthetic rubber is processed at around 122 degrees Fahrenheit.

Both cold and hot rubber are made of the same basic materials used in manufacturing standard GR-S rubber. They are butadiene and styrene. These two chemical products are polymerized together, a process in which big molecules are made out of little ones. A catalyst is employed in making both but the "chemical-reaction-aid" used in one is not the same as in the other.

Cold rubber for many purposes seems to be better than the ordinary GR-S type. Some claim that it is better for automobile tire treads and footwear than natural rubber. It has been

CHEMISTRY HALL LIBRARY

in commercial production for five years, following pilot plant production which began in 1946. Laboratory samples were made earlier. In its development several university and industrial research organizations played a part.

Since 1947 the commercial use of cold rubber has constantly increased. Late in the last year the amount of cold rubber made by the GR-S industry became greater than that of other GR-S rubber. Approximately 55% of the present product is cold rubber and 45% ordinary GR-S. Production of cold rubber is now approaching some 58,000 tons a month.

Good as cold rubber is, chemists are not entirely satisfied with it and are busily engaged in research to get even a better product. Success is claimed, and the cold rubber of today is a better product than that of five years ago. Even a product better still within the next few years is predicted.

Hints of the possibility of low-temperature rubber production antedate the government synthetic rubber program which began in 1940. It was early recognized that polymerization at low temperature would produce a rubber of better quality. Speed in production, however, was an essential at that time. The process of polymerizing at 122 degrees was better known so the method was used, leaving until after the war the development of the low-temperature process.

These same postwar years have witnessed much progress in developing several types of so-called synthetic rubber. The term "synthetic rubber" is actually a misnomer because the materials produced do not duplicate the chemical structure of natural rubber. But the term is now so widely used that it will probably stick.

GR-S is the most common type and perhaps few users know for what the letters stand. "GR" is Government Rubber. "S" designates one particular type. There are other types such as "I" and "M" and "P." GR-S is Government Rubber-Styrene. Sometimes it is called Buna-S but this name does not meet with universal favor. Buna-S is a German synthetic rubber and the name is of German origin. The "Bu" is for butadiene and the "na" from natrium, the Latin name for sodium. Buna-S for GR-S is misleading because GR-S does not contain sodium. The designation "GR" for man-made rubbers came when the American government took over the rubber program during World War II.

Announcements of new or improved synthetic rubbers are now quite common. This is to be expected because these rubber substitutes are relatively new and there is much to be learned about them and other types that may be developed. It might be said that the first successful synthetic rubber came to light 30 years ago. Much development work was done during the next 20 years, but general interest in them did not awaken until 1940 when war conditions shut America off from a supply of natural rubber, practically all of which came from Malaya and neighboring Asiatic countries.

This first successful synthetic rubber was revealed to the scientific world at a meeting in Akron, Ohio, in November, 1931. It was called "chloroprene" but is known today by the trade name "neoprene." Behind it was

years of laboratory work by a Notre Dame professor, Fr. Julius A. Nieuwland, and years of independent work by chemists of the Du Pont Company.

For years there was no connection between the two research projects. In 1925, however, Du Pont chemists learned of Fr. Nieuwland's work, and from then until chloroprene was produced the Notre Dame priest and Du Pont chemists worked closely together. Since 1931, Du Pont has been the manufacturer of neoprene, paying royalties for Fr. Nieuwland's work, not to Fr. Nieuwland himself, but to the religious order to which he belonged. The neoprene of today is vastly improved over the first types. Its widest use is perhaps as an insulating covering on electric wires.

Long before the days of Fr. Nieuwland, chemists had sought ways of making synthetic rubber. None had succeeded in making true rubber by laboratory methods but some had produced materials that seemed to have many of the properties of natural rubber and could be used as a substitute. For many reasons, however, they turned out to be unsatisfactory as rubber substitutes. It was not until chloroprene was developed that a practical synthetic rubber, from the standpoint of cost and quality, was obtained.

With the many improvements made in the past decade in synthetic rubber, America today can get along very well without natural rubber, or at least with a very small amount of the material that nature produces. This does not mean that the natural rubber will no longer be used in the United States. It will, and will be used in large quantities if available.

There are some applications for which no synthetic has yet been developed which is a suitable substitute for the natural material. Also there is the question of the relative costs of natural and synthetic rubbers. America for many years will be using vast quantities of the natural type. But in case of a war that would prevent imports to the United States, the nation would be well able to meet essential needs with home-made rubber.

Early in World War II, when Japanese aggression had cut the supply line of natural rubber from the Far East to America, the United States faced a crisis. Rubber was essential for the motorized equipment required in modern warfare. Synthetic rubber to supplement the meager stockpiles of natural rubber in the country seemed the solution. Most American rubber companies were producing small quantities. The government brought them together to pool their knowledge. Then the government provided money to build polymerization plants, which after construction were operated by rubber companies under the general direction of the government. GR-S was the principal product. This was because it could be made in large quantities at relatively low cost, and because GR-S resembles most nearly natural rubber in properties and qualities.

Other synthetic rubbers were made, however, and some of these are of particular importance. One is called Butyl rubber. It is GR-I, and is a butylene-butadiene polymer. It is very widely used for inner tubes for automobiles

because such tubes retain air even better than those made of natural rubber.

Silicone rubbers are synthetics playing a big part in the rubber field because of special properties they possess. Resistance to high and to low temperatures is one of these properties, as is also resistance to ultraviolet light. The newest type of silicone rubber, recently announced, contains the element silicon in two forms, the organic *silicone* and the inorganic *silica*. This gives it the highest strength ever recorded for this synthetic. The silica not only reinforces the rubber but also acts as a vulcanizing agent.

Among new types of synthetic rubber recently revealed is one known chemically as chlorosulfonated polythene which may some day become important in tire treads. It is a development of the Du Pont Company and is said to have excellent resistance to wear, heat and the weather. It has complete resistance to ozone, a specially active form of oxygen occurring in small amounts in the atmosphere, which causes deterioration in natural and many synthetic rubbers. Ability to blend with other rubbers is one of the new rubber's characteristics. So blended it gives the other synthetics greater resistance to weather and abrasion.

Still another new synthetic rubber, known as "Alfin," gives promise of being suitable for use in tires. Alfin, made from alcohol and olefin, is a material that easily converts the butadiene from oil refineries into a tough rubber. But the product can be made flexible and easy to process by the addition of an oil. According to Dr. H. Leverne Williams of Polymer Corporation, Ltd., Sarnia, Canada, this rubber is better than GR-S for some purposes, and may be cheaper because the oil used is much less expensive than the raw materials used with butadiene in making standard GR-S.

Even though America can now meet practically all its needs for rubber with home-made substitutes, so-called synthetic rubbers, the need for a plentiful supply of natural rubber is appreciated. But a supply from the present sources in the Far East is uncertain in wartimes. Therefore efforts are being made to promote rubber growing in the Western Hemisphere.

The trees that yield the latex for natural rubber are not native in the Far East. The native home of the Hevea tree, the rubber producer, is Brazil. Until about 1870 the Amazon Valley was the principal source of rubber for the world. An English planter was responsible for the introduction of the Brazilian Hevea into south Asia. There, in following years, strains of rubber trees far superior to their Brazilian parents have been developed.

Now through cooperation of the U. S. Department of Agriculture and 12 American tropical countries, rubber growing in the Western Hemisphere is staging a come-back. Several American rubber companies are playing important parts. Great difficulty has been experienced, however, with the South American leaf blight, a fungus disease which is the worst enemy of the rubber tree. Control of this fungus, now carried from tree to tree by the wind, is essential. Progress, however, is reported in an extensive program to develop strains of Hevea that combine high yield with disease resistance.

Comparative Statements From The Suppressed Reports

The Battery-Additive Case

BEFORE March 30, 1953 the idea that the Director of the National Bureau of Standards would be fired, because a testing division of the Bureau looked with a jaundiced eye on a battery additive, would have been unthinkable. It would have been as funny as the idea of firing the head of the Weather Bureau because of rain when you had planned a picnic.

On that date it happened in Washington.

Not only was this action taken in an unprecedented manner, by a new cabinet member (Secretary of Commerce Sinclair Weeks) with no consultation with men of professional competence to judge the disputed issues, if indeed any scientific issues were at stake. In addition, the published report of the Bureau's test of battery additives was suppressed.

The scientists of the nation have hastened to go on record against such morale-shattering action against Government scientific institutions by those elected and appointed as public servants. There has also been widespread editorial comment by newspaper editors expressing indignation at this action. In an attempt to take an objective viewpoint, many of these statements have called for new tests of battery additives.

A new examination of the several series of tests already made is more to the point. Toward that end, parallel statements from the documents in question are presented. Since these are so different in scope and purpose, it is necessary to select passages, and space does not allow us to reprint the reports as a whole, but these passages give a true picture of the tone of each report.

The documents quoted hereafter are the following:

NBS: National Bureau of Standards Circular 504, Battery Additives, United States Department of Commerce, Jan. 10, 1951. (This circular has .been withdrawn from circulation).

MIT: Effect of Battery Additive AD-X2 on Lead Acid Batteries. Report of the Massachusetts Institute of Technology submitted to the Select Committtee on Small Business, United States Senate, April 6, 1953. Printed for the use of the Select Committee on Small Business. U. S. Printing Office, Washington, 1953. (This report was not available for study until the above date, although it had been made several months earlier).

SSB: #109 12/18/52. Senate Small Business Committee for release Thursday a.m. papers December 18, 1952. A mimeographed circular containing as an appendix a statement by Dr. Keith J. Laidler, Associate Professor of Chemistry at Catholic University, Washington, D. C. This press release refers to "a commercial product designed to prolong the life expectancy of lead acid storage batteries. The

product is known as Battery AD-X2 and is produced by Pioneers, Inc., of Oakland, California."

C&EN: Chemical and Engineering News, published by The American Chemical Society, Vol. 30, No. 52, Dec. 29, 1952, pp. 5449-50, article: Senate Committee Assails NBS Stand on Battery Additive. This article contains exclusive statements by individuals affected. Some of these are quoted here.

The Tests

NBS p. 29. In the course of this investigation five batteries comprising 15 cells were subjected to an extended series of laboratory tests to determine the effect of adding specified amounts of sodium and magnesium sulfates in varying proportions. These batteries were in sound mechanical condition but were sulfated to the extent that their initial capacity after prolonged charging was about two-thirds of their rated capacity. Ten cells were treated with additives, and the remaining five were not treated.

MIT p. 10-11. It is relatively easy to obtain discarded batteries, but usually a discarded battery has deteriorated to such a degree, perhaps because of the development of mechanical defects due in considerable degree to chemical deterioration, that treatment with an additive would yield no beneficial effects. . . . Throughout the tests, the general tendency was not to treat with the additive those cells which showed up best in any one battery, but rather to reserve for treatment the poorer cells.

SSB p. 7. In the tests described in National Bureau of Standards Circular 504 only one battery was used for each additive. Two cells were treated and one was untreated; the inadequacy of the control used here does not require comment. The battery was previously submitted to severe overcharge which probably caused mechanical damage. No improvement due to Battery AD-X2 was revealed and the Bureau on the basis of this test with one battery dismissed the product as worthless.

SSB p. 5. In all cases these tests [on discarded batteries, which would not take a charge] showed positive results. Uncontrolled tests of this kind, however, can be criticized on the grounds that one cannot ever be certain that a battery will not take a charge; it is possible that on additional charging a battery would have taken the charge even if the additive had not been used. This criticism is not particularly convincing in view of the large number of cases in which this type of testing has been done, and especially in view of the fact that batteries have sometimes repeatedly refused to take a charge before treatment, but have taken it afterwards. *—Dr. Keith J. Laidler, Associate Prof. of Chemistry, C. U.*

NBS p. 7. A series of tests was set up to cover the following points:—

1. Change in specific gravity of solution produced by the additive.

2. Effect on capacity at normal discharge rates, such as the 5-hour rate, to determine whether there was a decrease in sulfation.

3. Effect on self-discharge or local action as an indication of improvement in retention of charge.

4. Effect on temperature of cells during charge as a means of prolonging life.

5. Effect on water consumption as an indication of whether the battery was taking the charge better with or without the treatment.

6. Simulation of an operational test where the batteries remained just under full charge for a long period but never on a complete discharge cycle to determine whether the treated cells would recharge more completely than untreated cells.

7. High-rate discharges starting at 300 amp then reducing to 200 amp and 100 amp successively to determine whether there is any change in cell performance under these conditions by treating the battery with additives.

8. Determination of the recuperative power of a cell when subjected to 300-amp load for a short interval followed by a rest period and repetition of the cycle. This is to indicate whether any improvement was made by the treatment.

9. Effect of several complete cycles to see if there was an increase in capacity and specific gravity.

SSB p. 3. Battery AD-X2 was developed by Mr. Jess M. Ritchie, now President of Pioneers, Inc. with the cooperation of the late Dr. Merle Randall, Professor Emeritus of Chemistry at the University of California and co-author (with G. N. Lewis) of "Thermodynamics and the Free Energy of Chemical Substances." At Professor Randall's suggestion, Mr. Ritchie prepared a large number of mixtures, giving each a special treatment, and tried each out on batteries. He finally, in 1947, arrived at a composition which had the desired effect of combating hard sulfation; it was first known as Protecto-Charge, its name being changed to Battery AD-X2 in 1948.

The Results

NBS p. 30. From the extensive laboratory and field tests covered in this investigation the fact remains that there has been no improvement found in the use of a series of commercial and specially prepared additives composed of magnesium and sodium sulfates either hydrated, partially hydrated or anhydrous.

The indiscriminate addition of these solutions and compounds to a battery is not advisable, although in some cases no particular harm may be done. It is a well-recognized principle in battery operation that acid should be added only to replace that which has been spilled or, in rare instances, to adjust the specific gravity to the required standard after the completion of a full charge. Materials containing iron, copper, mercury, nitrates, chlorides, glycerine, or alcohols should never be added to batteries as they will cause permanent damage to the battery.

The findings reported here are not confined to the Bureau's experience. Investigations by other laboratories, both Government and industrial, have arrived at similar conclusions on the various points discussed in this publication.

MIT p. 2. Summary of Results. For the cells tested:

(a) Among the cells in any chosen battery, all cells in such battery having been subjected to the same previous history, except for treatment with AD-X2, treated cells showed larger capacities than did untreated cells, both

being subjected to the same conditions of discharge.

(b) When AD-X2 was added to cells containing sediment, the amount of sediment decreased both while the battery was on charge and when it was not on charge.

(c) Cells treated with AD-X2 when on charge presented a markedly different appearance from those on charge without treatment. The gas evolved in the treated cells was in the form of minute bubbles, while that evolved in the untreated cells was in bubbles estimated to be 4 to 10 times as large as those evolved in the treated. The liquid surface in the treated cells presented a different appearance from that in the untreated cells.

(d) The surface of a negative plate in a treated cell was distinctly softer than the surface of a similar plate in an untreated cell, both having been subjected to the same charge conditions. Often, softening was first evident near the edges of the negative plate.

(e) Under similar charge conditions, treated cells lost less liquid than untreated cells.

(f) Under identical conditions of charge, treated cells operated 2 to 5 degrees Fahrenheit cooler than did untreated cells.

(g) During charge, and starting with discharged cells, treated cells gave higher hydrometric readings than did untreated cells, the differences being greater than could be explained on the basis of the treating material added.

(h) When AD-X2 was added to a cell containing a diluted electrolyte, as in a discharged cell, the conductivity of the electrolyte increased.

NBS p. 6. In all cases where sulfuric-acid solutions are concerned it is known that no long-term advantage is to be gained through increasing the specific gravity of the electrolyte. Momentarily there may be an increase in capacity, but the increased local action associated with the higher specific gravity will soon overcome this advantage.

SSB Quotation from testimonial to Pioneers, Inc.

"We are frank to say that we have never had occasion to use anything equal to your Battery AD-X2."

NBS p. 8. Tables 4, 5, 6, 7, and 8 show the capacity variations at the 20-amp rate when discharged immediately after charge and after a 16-hour stand before and after treatment. In practically every case the capacity decreased after treatment more than average. This definitely shows that there is no improvement of cell performance obtained by the use of such additives and further confirms the fact that such additives do not remove the products of sulfation. If the sulfate was removed from the plates, there would have been a marked increase in the capacity of the treated cells. This is not the case. In all cases it is seen that there is no significant difference between treated and untreated cells.

MIT p. 15. Lacking previous experience with storage batteries, we cannot draw upon past experience as to some of the distributions involved, nor can we obtain sufficient information to estimate them from the data at hand. For this reason we have often employed nonparametric tech-

niques to obtain estimates of significance. Since these are usually less sensitive than tests based upon specific distributions, the results would have been more impressive rather than less had parametric tests been available.

SSB p. 2. The Massachusetts Institute of Technology test, carried out at the special request of the Senate Small Business Committee, constituted by far the most thorough scientific tests of the effectiveness of Battery AD-X2. They demonstrate beyond reasonable doubt that this material is in fact valuable, and give complete support to the claims of the manufacturer. They also show additional desirable effects not specifically claimed by the manufacturer.

MIT p. 10. Limitations of Laboratory Results.—The difficulty of duplicating in the laboratory results obtained in the field is well recognized in engineering work. The laboratory evaluation of a material such as AD-X2 is further complicated by the great variation in the samples subjected to test, even though every effort be made to so select test units as to minimize such variation. Usually, an evaluation of how a product will act under field conditions can be obtained only after extensive laboratory experimentation. Even after such experimentation, it is common practice in engineering work to subject products to field tests. How a given innovation will perform under use conditions is the true test of its worth. For this reason, laboratory findings must be supplemented by field use data if a true evaluation is to be obtained.

The Conclusions

C&EN p. 5450. The National Bureau of Standards has not yet received a copy of the MIT report, but portions and interpretations of it have appeared in the Senate Committee's release. Such information presently at hand regarding the MIT report does not contradict the findings of the National Bureau of Standards for the relationship of the MIT study to normal battery operation is not obvious. It is interesting to note that the MIT report, in at least one place, carefully avoids a claim that they have established properties which are beneficial to normal battery operation.—*Allen V. Astin, Director, N.B.S.*

NBS p. 1. Various preparations of liquids and solids have been sold to the public as means of rejuvenating worn out or so-called "dead" batteries. The majority of these materials are composed of varying proportions of magnesium sulfate and sodium sulfate. Extensive laboratory and field tests have been made covering various proportions of magnesium and sodium sulfates. The results show no difference between the batteries treated with these mixtures and similar untreated batteries used as control.

SSB p. 2. (Concluding Remarks). It is in fact known, as seen above, that sodium and magnesium sulfates do have some action, even though an unsatisfactory one. It is moreover known in physical chemistry that minute traces of substances (catalysts) can have a marked effect on the rates of reaction. Consequently, there is no reason why a mixture of sodium and magnesium sulfates contaminated by other materials could not be effective.

C&EN p. 5450. The news release appears to be more in the nature of a legal or political document rather than a well authenticated and impartial technical report. The very criticisms offered to condemn and discredit the Bureau of Standards and Dr. Vinal would seem to apply to this report. Who are these gentlemen and what is their battery background? Who is to decide whether results are significant or not in battery service? Surely not college professors without any practical experience in the battery industry even though they review these theoretical phases of battery chemistry correctly.

No data are given to support their views and the statements which appear to substantiate conclusions are carefully worded so that no quarrel may be had with what they say. It may be so but is it? And if so, is it really pertinent to battery operations. Again the tendency is to discredit those who differ with them and to imply the battery industry is trying to suppress a legitimate battery aid.—*C. C. Rose, Willard Storage Battery Co.*

NBS p. 5. Excessive sulfation can be avoided with reasonable care. It is doubtless true that the liability to troublesome sulfation of lead batteries has been exaggerated by those exploiting so-called cures.

MIT p. 21. However, one can certainly not conclude from this small amount of data that the treatment will always produce a plate which is softer than one not treated in the same battery.

SSB p. 10. After treatment the negative plates were much softer than in untreated cells; This result was statistically significant and indicates in a very direct way the action of the additive on hard lead sulfate.—*Keith J. Laidler, C. U.*

C&EN p. 5450. However, it does seem that the opinion of the chemist best qualified to know is going to be overwhelmed by a mass of irrelevant or nonpertinent data presented by those who can out-talk him.—*C. C. Rose, Willard Storage Battery Co.*

SSB p. 4. In 1948, however, Pioneers, Inc. suffered a serious set-back, because at that time they were informed by the National Bureau of Standards that various materials containing magnesium and sodium sulfate had been tested, and that the results indicated that all such compositions to be worthless. . . .

In view of the reputation of the National Bureau of Standards it is not surprising that Pioneers, Inc. have been seriously handicapped by the wide circulation of these condemnations of their product. In the Spring of 1952 Mr. Ritchie, still absolutely convinced of the value of Battery AD-X2, decided to bring the matter to a head and to force a final decision as to its effectiveness.

United States Testing Co. Inc. Report of Jan. 28, 1953. Read into the Congressional Record under date of April 27, 1953. Results: The use of battery AD-X2 as an additive is effective, because it increases the charging and discharging efficiency, reduces the internal operating temperatures, does not harm lead acid batteries, and reduces shedding of active material.

The Men

SSB Jess M. Ritchie, President [of Pioneers, Inc.] ". . . was born in Sharpe County, Arkansas on Novem-

ber 7, 1909. Self educated. Served in the 31st Infantry, Philippine Islands as a youth. Upon returning to the United States in 1927 began working and studying construction work. Also began studying psychology. Took correspondence course, International Correspondence School in Highway Engineering. Did not finish this course. Became Operating Engineer 1930, General Engineering Contractor in 1945 California Class A License. Doctorate in Psychology, College of Universal Truth, November 1949. Became President of Pioneers, Inc., Superintendent of Construction for the Drake-Utah-Grove operations on a Contract for the United States Army Engineers, an eighty million dollar project. Jess M. Ritchie holds professional membership in the Society of Automotive Engineers, International Signalmens Association, LeTourneau Certified Operators, Card No. T689 and belongs to the following service clubs: Oakland Lions Club, Lake Merritt Breakfast Club, Oakland Boys Club, Athens Athletic Club and the 100 Club in Oakland."

WHO'S WHO in America, 1952-3, p. 2786 ASTIN, Allen V(arley), physicist; b. Salt Lake City, June 12, 1904; s. John Andrew and Catherine (Varley) A.; A.B., U. Utah, 1925; M.S., N.Y.U., 1926; Ph.D., 1928; m. Margaret L. Mackenzie, Aug. 31, 1927; children—John Allen, Alexander William. Nat. Research Council fellow Johns Hopkins, 1928-30; research asso. utilities research com. Nat. Bur. Standards, 1930-32, physicist since 1932, asst. chief ordnance development div., 1944-48, chief electronics and ordnance div., 1948-50, asso. dir. since 1951. Decorated Pres. Certificate of Merit (U.S.); King's Medal (United Kingdom). Fellow Am. Phys. Soc.; mem. Inst. Radio Engrs., Washington Philos. Soc., Washington Acad. Scis., Am. Ordnance Assn., Sigma Xi, Phi Kappa Phi. Club: Cosmos. Home: 5008 Battery Lane, Bethesda 14, Md. Office: National Bureau of Standards, Washington 25.

How Storage Battery Works

The fundamental facts about storage batteries are told in the following extract from the National Bureau of Standards Circular 504, issued in 1951, and now withdrawn from sale on orders from Secretary of Commerce Sinclair Weeks, as an aftermath of the ouster of Dr. A. V. Astin, director of the Bureau of Standards:

A storage battery may be considered as an electrochemical apparatus in which electric energy is stored as chemical energy.

When a storage battery is discharged the chemical energy is transformed into electric energy as the lead dioxide and sponge lead react with the sulfuric acid to form lead sulfate at both the positive and negative plates. The current flows from the positive to the negative plate externally and from the negative to the positive plate internally to complete the cycle of transformation of chemical energy into electric energy.

The lead sulfate formed during the discharge forms a surface coating over most of the surface of each particle of finely divided sponge lead or lead dioxide. The center of the particle, being nonporous, is not converted to lead sulfate. Each particle is in intimate contact with the next particle so that electrically continuous flow of current is maintained. . . .

New Series of Nuclear Tests Begun by March 17 Explosion

Nuclear Bomb Alerts Civil Defense

The first of the atomic explosive tests set off this spring by the Atomic Energy Commission at Yucca Flats, Nevada, was witnessed by Science Service's Director, Watson Davis. His impressions of the event, and explanations of some of the after effects, fill out for readers the glimpses they may have had via television and radio of this, the third public demonstration of atomic bombs at close range.

➤ THIS year's "Saint Pat" dawn atomic explosion in many ways duplicated the world's first atomic "trinity" explosion at Alamogordo, N. Mex., July, 1945.

Not really a bomb in the sense of a military weapon, it was a "nuclear diagnostic test" in AEC language, as was the famous first.

The explosion occurred at the top of a steel tower which was completely vaporized as the ball of fire touched the ground. This may have dug a radiologically hot crater.

Rising at dawn like a sudden super-sun flash, colorations lacking in recent day-time explosions were seen. The persisting violet after-glow is due to gamma or X-ray-like radiation affecting the nitrogen and oxygen of the air.

Incongruous sounding, nevertheless the glorious white of the mushroom cloud is due to ice particles forming where seconds before were hottest earthly temperatures, about a million degrees.

This explosion can shake people out of complacency, just as it jarred the two typical houses, over 50 autos and numerous dummies, standing in for you and me if sudden atomic attack comes. That's why civil defense was a top consideration in this test.

You have not read, in all probability, what one expert described as the "most horrible book ever written." It was officially published nearly three years ago and its title is "The Effects of Atomic Weapons." Even though it is pre-hydrogen bomb and based largely on what happened to two Japanese cities, Hiroshima and Nagasaki, it is a preview of what might happen anywhere in a trigger-happy world.

This spring those charged with civil defense for a blasé and "it can't happen to me" population have been watching the book go into dramatic, full-scale production with just a tiny, two-house sample against which an atomic bomb was loosed. The observers shuddered as their imaginations applied what could happen to the cities from which they came.

The kind of bomb shown again to the nation, via press, radio and television, on Yucca Flat is a bit old-hat. Eniwetok is the place they let loose the really big ones nowadays, the hydrogen ones.

But out-moded or not, the A-bomb is something to ponder and fear. There is not much chance of human survival within a mile of the atomic blast. The atomic rescue efforts will have to be

made by people who live ten or more miles away. Atomic civil defense that is selfishly concentrated upon one's own city alone will be wasted largely if your city is target zero.

A great show: If only it were not a prologue to possible tragedy.

The Lesson

If you are caught in your auto during an A-bomb alert, be sure to leave your windows open. In the test explosion March 17, autos one and three-quarters and two miles away had their tops dished in when they had closed windows. The smashing-in of the top would have broken the necks or bashed in the heads of occupants. Autos with open windows did not suffer much damage. No windows were broken or tires flattened so far out.

Closer to zero position of the shot cars were turned over, moved many feet and some set afire.

Typical frame houses at 3,500 feet (about three-quarters of a mile) and 7,500 feet were badly damaged. The house closer in was completely wrecked, dumping debris on air raid shelters in its basement. The most distant house was so damaged as to be uninhabitable without major repairs with windows, furniture, plaster and dummy inhabitants strewn over weakened floors.

Blast Waves

Blast waves from an atomic bomb sometimes rise as high as 50 miles into the sky and then bounce back to the ground, research by weathermen in connection with the A-bomb explosions in Nevada has shown. The bounce sometimes throws the blast back onto the ground as far as 600 miles away.

Various temperature inversions and normally found layers of the atmosphere can act as reflecting surfaces for blast waves from an atomic bomb or from any explosion. That is why some of the force of the Nevada test explosions was felt as far away as California, Arizona and Utah. That is why some windows were broken in Las Vegas and other places.

Claims for blast damage from the 20 test explosions which have been settled amount to $42,929, the Atomic Energy Commission says. Weather forecasts in all probability have kept this sum as small as it is. Some tests were postponed on the advice of meteorlogists.

The general theory that temperature inversions, the troposphere, the ozonosphere and the ionosphere—the last being 50 miles up—are the cause for the seemingly erratic action of blast waves from explosions has been known for some time. However, meteorologists say that never before has there been the opportunity for controlled experiments in blast wave propagation of this number or size.

The AEC says that a fair degree of accuracy was achieved in predicting the pattern of blast waves from any one particular test explosion. However, when the weather forecasts are off, the prediction of blast wave patterns are off too.

Signs of the Bomb

➤ Fission products and atomic fragments of the bomb case which would tell observers that an atomic bomb had exploded have been calculated. These estimates were reported before the meeting of the American Chemical Society at Los Angeles, by Dr. L. R.

Bunney of the U. S. Naval Radiological Defense Laboratory in San Francisco.

Working with his colleague, Dr. N. E. Ballou, and using both experimental and theoretical data, Dr. Bunney concludes that uranium and plutonium would be found in air samples as evidence of such an explosion, and that there would appear in addition as fission products elements from zinc through gladolinium in the periodic table.

Most fission products would be in the form of oxides by the time they had cooled to ordinary temperatures, Dr. Bunney said, although a number of other combinations would be possible. Nitrogen resulting from the explosion would be uncombined, as would the rare gases. Silver, he believes, would be found as a metal.

Tests Don't Contaminate

➤ DON'T WORRY about the atomic test explosions in Nevada contaminating the atmosphere and the ground unduly.

An extensive investigation by Atomic Energy Commission experts cooperating with the U. S. Weather Bureau shows the dose of radiation is minute, although background radiation does increase markedly even thousands of miles from the bomb-bursts. But this is for brief periods only and the long-lived radioactivity that persists is much less than the natural activity of the earth's surface and atmosphere.

Merril Eisenbud and John H. Harley of the AEC New York Operations Office made this report to the American Association for the Advancement of Science.

Energy from Matter Annihilation

➤ THE POSSIBILITY of obtaining vast amounts of energy from the annihilation of matter was suggested to National Science Talent Search winners this year by Dr. I. I. Rabi, Nobelist in physics of Columbia University, New York.

Explaining that the opportunities in exploration of matter and energy are "open-ended," Dr. Rabi urged the young scientists to help discover new methods of energy production by investigation of particles of matter.

The existence or creation of antimatter, or the negative analogue of the proton (heart of the hydrogen atom), is theoretically possible. If this particle were to combine with a proton, two billion electron volts of energy would be let loose. This is a thousand times as much as the energy release of the similar annihilation of an electron (particle of electricity) which is a million electron volts.

Thus, Dr. Rabi explained, there are probably discoverable in the future methods of energy production much greater than the fission of matter in the atomic bomb or the conversion of hydrogen into helium such as occurs by fusion in the H-bomb and the sun.

Studies of protons and neutrons, now under way in powerful accelerators which are beginning to duplicate the energies of the cosmic rays, may lead to the discovery of the new potential sources of energy. The number of kinds of subatomic particles known to exist has increased in the past few years and physicists are exploring particularly the mesons first found in the debris of cosmic ray collisions.

Gravitation and Electromagnetism Both Fit Into New Field Equations

Einstein Revises His Theory

▶ Prof. Albert Einstein has revised his generalized theory of gravitation. This may be a major step forward toward the goal of complete description of the physical universe—gravitational, electrical and nuclear forces—by a single theory.

His improved theory is based on a new method which compares the "strength" of different systems of equations. In the earlier version of his theory, published in 1950, a choice of several sets of equations was possible. Now the method which allows choosing a particular set of equations is set forth.

Einstein's earlier doubts concerning the choice of field equations have been dispelled by his new method, although mathematical difficulties have so far prevented checking the theory against known experimental facts.

"Nevertheless, I consider it unjustified to assert, a priori," Einstein asserts, "that such a theory is unable to arrive at the atomistic character of energy."

The new development takes a large stride toward one of the great aims of theoretical physics, to find a single theory that will describe both gravitation and electromagnetism. It is presented as an appendix to the fourth edition of Einstein's book, "The Meaning of Relativity," published by Princeton University Press.

Einstein shows how an approximation of his generalized gravitation equation leads to two other sets of equations, one of which is a generalization of Maxwell's famous electromagnetic equations.

This, Einstein states, makes it understandable why the electromagnetic and gravitational field seemed so independent of one another in the previous development of our knowledge about the behavior of weak fields. In the more rigorous theory this independence no longer holds.

The new theory runs directly against the main current of modern physical thought. It is a field theory rather than a particle theory such as is favored by most other physicists.

In a discussion of modern physics, Einstein expresses his belief that attempts to give a complete description of the real situation with the formalism of the present quantum theory must fail.

Einstein, however, sees in the present situation no possible way other than a pure field theory, which then, however, has before it the gigantic task of deriving the atomic character of energy.

It was in 1905 that Einstein suggested that the laws of physics as we observe them may be in no way dependent upon how fast we are moving through space. He proposed that it is only how fast an object is moving relative to us that can affect the way things on this object appear to act.

Scientists found that changes in the properties of objects moving at high speeds could be accounted for by this theory. This theory also stated the equivalence of mass and energy, $E = mc^2$, basic to the atom bomb.

The idea of developing a generalized field theory has been a major goal of physicists since about 1920. A vast store of knowledge has been gained from experiments, but no single theory has previously been able to explain and describe it all.

The world will have to wait to see if the new theory will influence the next half of the century as profoundly as Einstein's theory of relativity did the first half.

Einstein, now at the Institute for Advanced Study in Princeton, was awarded the Nobel Prize for Physics in 1921.

New Light from Hydrogen Atom

➤ EXCITED hearts of hydrogen atoms are exciting physicists. For the first time in nearly 30 years, a new series of atomic spectrum lines has been found. This is the sixth series.

Light given off by hydrogen, the most fundamental element, when an electric spark jumps through a tube containing that gas, has just been analyzed into the five well-known series of lines by which atomic energy is measured, plus a sixth series. Prediction of this sixth series of lines, in the infrared part of the spectrum, has been made during the past three decades.

Announcement that the new kind of invisible light from the hydrogen atom has been found was made by Dr. Curtis J. Humphreys of the National Bureau of Standards. Earlier discoveries of the five series of lines were made by physicists whose names the line series carry. These are the Lyman series in the ultraviolet region of the spectrum, the Balmer series in visible light, and the Paschen, Brackett and Pfund series in the infrared.

Possibility of a seventh series of lines, to be found still farther toward the infrared end of the spectrum, where light waves change into heat waves, is made by Dr. Humphreys.

Shock Wave Photographs

➤ A CAMERA that takes pictures of invisible things was instrumental in pushing American pilots through the sound barrier into supersonic flight.

Dr. Marjorie W. Evans of the Armour Research Foundation of Illinois Institute of Technology told the Industrial Photographers of America that schlieren photographs taken in wind tunnels revealed that the thick, curved wing surfaces of conventional planes should be redesigned into thin, symmetrical surfaces for near-sonic flight.

The system works on the principle of different air densities transmitting different amounts of light. Two concave mirrors, a light source and a knife edge form the heart of the system. The knife edge is used to keep certain light rays from entering the camera.

Better Understanding of Cells Yields Clues For Further Search

Progress in Cancer Research

➤ ONE OF medicine's big guns against cancer, the two million volt X-ray generator at the Massachusetts Institute of Technology, has brought results surpassing the expectations of Prof. John Trump of the Institute, Dr. Hugh F. Hare of the Lahey Clinic who is in charge of the treatments, and the American Cancer Society.

No effort has been made to estimate the cure rate because less than five years have passed since the machine was first used in treating patients. But 293 of the 455 patients treated between October 1949 and October 1952 are reported without apparent disease symptoms. The American Cancer Society announces the following statistics:

Without evidence of disease were 12 of 25 patients with cancer of the bladder, 13 of 26 brain cancers, 9 of 21 breast cancers, 23 of 32 uterine cervical cancers, 9 of 21 cancers of the esophagus, 17 of 21 cancers of the larynx, 2 of 2 liver and spleen cancers, 17 of 37 lung cancers, 25 of 39 lymphoid tumors, 2 of 2 pancreatic cancers, 8 of 15 stomach cancers, 37 of 50 thyroid cancers, 2 of 2 uterine cancers, 2 of 3 kidney cancers and 8 of 8 parotid gland tumors.

The figures are particularly impressive in the light of the advanced stage of many cases, many of whom had received no benefit from other types of treatment. Several types of cancers—such as of the lung, stomach and pancreas—have very low rates of cure by any means.

Cells From Simple Materials

➤ CELLS of the body do part of their job of building new cells by starting with the simplest materials.

Unlike a woman making a dress, who cuts out ready-made material and sews it together with the aid of a pattern, the cell first tears down the material to the very threads, as it were, and then weaves them directly into the finished product.

This is true at least for the cell's production of an enzyme, made by the cell to convert its food into living matter.

This finding, contrary to previous theory, and believed an important clue to the secret of cell growth, including cancerous growth, was made by Prof. Sol Spiegelman and Dr. Harlyn Halvorson, microbiologists of the University of Illinois.

Since doing this work, Dr. Halvorson has become associated with the University of Michigan.

Clue in Pituitary Gland

➤ THE PITUITARY gland in the head is now under suspicion as playing a villain's role in the development of cancer.

The suspicion comes from rat experiments at Stanford University. In the experiments, rats that had their pituitary glands removed failed to get cancer when fed a cancer-producing

azo dye. Other rats, with pituitary glands left in their heads, developed large cancerous growths in their livers after 14 to 19 weeks of the dye-containing diet.

The pituitary gland, at the base of the brain, influences other glands of the body, including the adrenal glands. Next step in the research is to learn which function or gland influence of the pituitary is involved in the cancer picture.

The research so far has been carried out by Prof. A. Clark Griffin, Drs. A. P. Rinfret and Charles Robertson, Mrs. Marjorie O'Neal and V. F. Corsigilia.

Gene Stuff Like Virus

➤ A VIRUS-LIKE action of cancer cell gene material has been discovered by Drs. Abraham Cantarow, Joseph Stasney and Karl E. Paschkis of Jefferson Medical College, Philadelphia.

The finding was made when these scientists succeeded in inducing lymphatic cancers in rats by injecting gene material from cancer cells.

The scientists extracted the gene material by mincing the cells, spinning the mince at different speeds and separating the spun down portions. They tested the homogenate against the presence of whole cells by pipetting into it 100 whole cells. Because they could detect each of the hundred cells—and no others—in the mince, they were convinced that similar minces had no cells.

When they injected the gene mince under the skin of rats, about 40% of the animals quickly developed cancers of the lymphatic tissues.

Now the scientists have found that the 60% which did not develop cancer when treated with the mince do not develop it when they are injected with whole cancer cells either. They seem to be rendered resistant to this type of cancer.

They also have found that some of the animals develop cancer only for a short period. Then the cancer disappears. When the rats again are injected either with mince or whole cells, they prove immune. No sign of cancer arises from the second treatment.

The scientists now are trying to separate out of the mince the specific chemical substances responsible for production of the cancer.

Papaya Enzyme

➤ EARLY DETECTION of stomach cancer probably can be achieved best by microscopic examination of cells taken from the stomach lining.

This is indicated by a report by a group of University of California School of Medicine doctors in the journal, *Surgery, Gynecology and Obstetrics.*

The detection technique, called cytological diagnosis, has been used successfully in cervical and lung cancer. Its application to stomach cancer has been difficult because of the trouble encountered in obtaining cells direct from the stomach wall.

The California scientists have overcome this problem by the use of papain to digest and remove the mucous layer overlying the stomach wall.

The papain technique has now been used on 400 patients, and a marked improvement is noted over results obtained in a study of 600 patients in whom conventional methods of obtaining stomach cells were used.

With papain, 30, or 71.4% of 42 proved malignancies were detected, an improvement over the 51.1% diagnosis by conventional methods. A review of the data on the 400 patients shows that improvement during the course of the papain study can raise the accuracy to about 85%.

The doctors pointed especially to the detection of five early cancers in which diagnosis by X-ray was either questionable or in error. Before cytological diagnosis, ulcers had been diagnosed in four of the patients, multiple polyps in a fifth. In all five cases, the cancers were detected and removed before they had a chance to spread.

There is growing evidence that cytology is the most efficient means of diagnosing early lesions, said the scientists, Drs. Milton Rosenthal, Seymour M. Farber, Orville F. Grimes, and Mr. James T. Harrison.

If the tests are used in individuals over 35 years of age who complain of chronic indigestion, many early, operable cases of cancer would be uncovered, they added, thus reducing mortality from this source.

Synthetic Hormone

➤ EIGHTEEN women with advanced inoperable breast cancer have been helped by a new hormone drug, Dr. George C. Escher of Memorial Hospital and Sloan Kettering Institute, New York, reported at the New Orleans meeting of the southern section of the American Federation for Clinical Research.

The drug is a synthetic hormone called androstanolone. It is a male hormone type of chemical but has weak masculinizing effects. For this reason it seems preferable to testosterone, male hormone used for some years in treatment of inoperable breast cancer.

Although only 43% of the 42 patients treated showed objective improvement, a larger proportion showed improvement in symptoms such as pain, lack of appetite and generally unwell feeling. This symptomatic improvement occurred in 31 of the 36 out of the 42 treated who had symptoms. In 19 of the 31, however, the symptomatic improvement came without objective improvement, or signs of the drug affecting the cancerous condition itself.

Androstanolone was originally prepared by two European scientists and Nobel Prize winners, the German, Dr. A. Butenandt, and the Swiss, Dr. L. Ruzicka. Because of its weak male hormone action, it was not given much attention, but Prof. A. Lipschutz of the Santiago laboratories of the Chilean Public Health Service found it had anti-tumor effects in laboratory animals. Dr. Escher and associates tried it in a screening of various hormones that might be more effective than testosterone.

The drug is now being made under the name, Neodrol, by Foundation Laboratories of New York, an associate of the Syntex laboratories in Mexico.

Working with Dr. Escher in its trials were Drs. Joseph H. Farrow, Dorothy W. Sved, Guy Robbins, Helen Q. Woodward and Norman E. Treves.

Restrain Cell Division

➤ HOPE FOR chemical treatment of cancer through a new class of compounds is suggested by the American

Cancer Society in announcing findings of research it supports.

The finding is that cell division, unrestrained in cancer, can be restrained by chemicals which exist in all living cells. This was discovered in research by Dr. Ernst J. Dornfeld of Oregon State College.

The compounds are called nucleotides. They come together to form nucleic acids which, with protein, make up the basic living substance.

Dr. Dornfeld found that two types of cells, those covering embryonic rat ovaries and those in tissues snipped from young rat ears, will almost stop growing if treated with three of the four kinds of nucleotides. The three are cytidylic, guanylic and adenylic acids. The exception, which did not slow cell growth, is uridylic acid.

If these or related nucleotides exercise a more potent anti-growth effect on cancer cells than on normal cells, or if they completely stop the ever-dividing cancer cells, the nucleotides in some form might be used to treat cancer.

Be Sure Sweaters Won't Go Up in Flames

➤ To GUARD yourself and your family from serious, perhaps fatal, clothing burns, ask stores where you shop if the sweaters or clothing you are buying have passed flammability tests.

This is the best way to be sure that you do not get any clothing dangerously likely to go up in flames, Roger M. Wingate of the National Fire Protection Association told Science Service. The Association, made up of representatives of government agencies, retailers and manufacturers, is trying to establish, by scientific tests, a standard that will show exactly how flammable fabrics are.

Even with these tests, however, Mr. Wingate, vice-president of Liberty Mutual Fire Insurance Co., Boston, said that the most important thing is for the consumers to demand that their clothing meet the minimum standards. These depend on the rate at which fabrics burn, for it is the rapid burning of clothes that most often causes the serious or fatal burns. About one-third of the 12,000 deaths from fire burns each year result from clothing burns.

Many materials that are a menace to human life are sold in every store throughout the country without any warning that they are highly flammable, like the torch sweaters and the cowboy suits sold a few years ago.

How fast the dress or suit you are wearing will burn depends not only on the material, but on how that material has been treated. It is the brushing, not the rayon, that makes brushed rayon sweaters flare up like torches. Cotton materials with a similar nap are just as flammable as rayon. But flat weave cotton or rayon, sheeting, and cotton or rayon prints are not dangerously flammable.

The first use of a mixture of rubber in asphalt for a road surface was in the Netherlands; many such roads are now in experimental use in England and the United States.

New Reducing Diet Limits Protein Amount

How to Lose Appetite

➤ A NEW KIND of reducing diet is being tested on some very fat people at the Hospital of the Rockefeller Institute for Medical Research in New York City.

Exact details have not yet been worked out and the doctors testing it are not yet ready to recommend it indiscriminately. It might be harmful to people under certain conditions.

If it proves safe and effective, however, it will be popular. Those on the diet will not feel hungry or weak. They will be able to eat all the sweet and fat and starchy foods they want.

The point is, they will not want much of these fattening foods. In fact, they will not have the appetite for eating too much of any food.

The diet will restrict those following it in the amount of protein they can eat. Only a small amount of foods such as meat, milk, eggs, fish and poultry will be allowed. Even the high protein vegetables such as peas and beans will be limited.

The new diet, now under trial as a reducing diet, is based on the discovery that when the amount of protein is reduced, appetite goes down and weight falls off. This discovery was made by Drs. Vincent P. Dole, Lewis K. Dahl, Irving L. Schwartz, George C. Cotzias, John H. Thaysen and Cecilia Harris.

The finding was made on patients with high blood pressure. Patients put on the rice-fruit diet developed by Dr. Walter Kempner at Duke University, Durham, N. C., rapidly lost weight. During this period of rapid weight loss, they took a reduced number of calories, in other words, ate less. But when their weight stabilized at a new, low level, they began to take in about as many calories as before, even though by that time, after four months on the rice-fruit diet, they were "heartily bored with the menu."

Seeking the dietary factor responsible for this, and also its importance in treating high blood pressure, led to discovery of the appetite-decreasing effect of the low protein diet.

So far as the blood pressure was concerned, salt, or rather the sodium in salt, was the important factor. When this was restricted to a very low level, blood pressure was reduced even when the protein intake was varied ten-fold.

When the protein was reduced, however, there was always a reduction in weight and when the protein was increased there was always an increase in weight.

The amount of protein in the diet was low, but not too low for good health. The scientists point out that a large number, perhaps a majority, of the people in the world live, work and reproduce on diets that are at least as restricted.

For growing children, patients with liver disease or after operations, for

alcoholics and perhaps for many others that diet might be too restricted.

Why the low protein diet reduces appetite and weight is explained by the theory that with reduced protein intake, there is a reduced rate in the body's metabolic processes for handling protein. All the metabolic rates then get out of balance and some chemicals from other foods get into a state of relative surplus.

The appetite is therefore depressed and the "inventory" of these other chemicals is allowed to shrink until a new steady state is reached. This takes several months. After that the appetite returns to a balance with expenditure. In other words, the person then eats only as much as he needs to replace the energy he uses.

Details of the study are reported in the *Journal of Clinical Investigation*.

Eat Like Cow? Need 12,500 Calories

➤ Do you eat like a cow?

Experiments by the U. S. Department of Agriculture show that a 400-pound calf uses 5,400 calories a day to maintain its weight. To gain about 1½ pounds a day, a calf needs 12,500 calories.

Recommended daily allowance by the National Research Council for a moderately active woman (123 pounds) call for 2,500 calories a day; for a moderately active man (154 pounds), 3,000 calories.

Paints to Show What's Red Hot

➤ "Red hot" may have a new meaning soon as the result of a new series of special purpose paints being developed at the Naval Research Laboratory in Washington, D. C., and reported by A. L. Alexander, J. E. Cowling and Peter King to the Los Angeles meeting of the American Chemical Society.

Metallic compounds which change color when they reach certain temperatures have been made into paints by this research team. These paints can be spread or sprayed onto aircraft engines, industrial heat exchangers and other inaccessible spots where it is important to know the maximum temperatures reached during a run, but difficult to attach measuring instruments.

Combining a solution of colorless methacrylate resin with the brightly colored compounds of cobalt, nickel, iron, manganese, chromium and copper, the Naval Research Laboratory chemists have produced a whole series of tell-tale paints which can be used to determine the heat developed over a wide range of temperatures. Stripes of several of these pigments can give a detailed history of the treatment the machine part has received.

In fighting insect pests, a mixture of two or more substances often does better work than one alone.

Human Brain Chemistry Different From Rat's

Glutamate Nourishes Brain Tissue

► SOME BASIC ideas about the chemistry of the human brain are being changed in research at the University of California School of Medicine.

The studies are being made with brain tissues removed from mentally ill patients receiving lobotomy operations.

Until recently most of our ideas about human brain chemistry came from test tube studies of rat and guinea pig brain tissue because "living" human brain tissue has been very difficult to get for test tube studies.

Now Dr. H. W. Elliott and V. C. Sutherland of the California school find big differences between rat and human brain chemistry. The first and biggest difference is the way the human and rat brain tissue handles glucose, a common sugar which is apparently the main fuel for the brain.

Research has shown that fresh rat brain tissue in a test tube will deteriorate rapidly if glucose is not placed in the solution. It was assumed that the same thing would happen to human brain tissue.

But the California scientists found that fresh human brain tissue will respire, or "breathe" at a fairly high level for three hours in the test tube without the addition of glucose.

This indicates that there must be some substance in the human brain tissue capable of keeping up respiration which is either not present or is incapable of doing the same job in rat brain.

Further experiments pointed to glutamate, an amino acid salt, as the possible sustaining substance. In separate experiments, glutamate kept respiration up in the human brain just as high as glucose could. Glutamate will not do the same thing in rat brain tissue.

Since glutamate is the building block of proteins, the scientists figure that proteins may provide more energy for the brain than has been supposed.

This conclusion ties in with clinical studies on hypoglycemia, induced by insulin shock, in which the system suffers from a shortage of sugar. Glucose was the only thing that could bring patients out of such shocks until a physician found that glutamate would do the same thing.

The studies were made by putting brain tissue in a nourishing solution in a test tube, then pumping pure oxygen through the tube so the fresh tissue could stay "alive" and "breathe."

The scientists said the brain tissue from the mentally disturbed patients appeared to be normal in structure, and no differences in test tube function were noted from one mental condition to another. However, the existence of "biochemical lesions" which might contribute to both the psychotic condition and abnormal chemistry can not be completely discounted.

—This and back cover photos courtesy E. I. du Pont de Nemours & Co.

➤ NINE YEARS *ago the titanium crystals held here by Ted McKinley of Du Pon were peak production of this new construction metal.*

Metal Once a Curiosity
Now in Commercial Production

Tons of Titanium

➤ LIGHTER than iron, stronger than aluminum, less affected by corrosion than any metal in common use, titanium has the properties that make worth while all the trouble its successful isolation has cost.

Titanium is not a rare element. It is found in the beach sands of many parts of the world, including Norway, France, India, Japan, Russia, Canada and the United States. The two chief ores are *rutile*, titanium dioxide, and *ilmenite*, a ferrotitanate.

The ferrotitanium compound is the one in which titanium was first discovered. The presence of iron complicated the tests by which its discoverers established its individuality, and for a long time no attempt was made to use the titaniferous ore except to give special qualities to steel.

Use of titanium dioxide as a pigment in paint has developed during the present century. This compound is capable of crystallizing in several different systems. Such compounds are found in nature, giving minor ores *anatase* or *octahedrite* and *brookite* in addition to *rutile*. But for pigment use, rutile is the preferred form of crystalline structure. It reflects more light from its crystal planes than the other varieties. This gives TiO_2 its reputation as the "whitest pigment."

Titanium forms compounds readily not only with oxygen, but with nitrogen as well. Unless protected from contact with air, contamination with such compounds makes the metal brittle and unworkable. This was one of the critical problems in the production in quantity of this important new material.

Now that ton-lot production has been achieved, it is coming into use for jet engines, airplane parts and other uses where its unique combination of valuable qualities are essential. Titanium seems to be leading the way into the age of specialized metals.

On the Back Cover

➤ TITANIUM *today is produced in crane-sized chunks weighing 2500 pounds, as shown here by Du Pont's operator, Paul Bowen. From the decision in 1944 by Du Pont to turn to production of titanium metal, three year's work was necessary to achieve the first pilot plant. Du Pont was already familiar with titanium compounds in making paint. Production of the metal necessitated much additional research because titanium's chemical behavior is so different from that of the well-known metals. Remington Arms Co. in 1949 undertook the design of the rolling mill to turn 10-pound titanium ingots into the first sheets of the new material. By 1951, Du Pont and its associated companies felt they had at last achieved commercial production of titanium with a supply of 400 tons a year and the price down to $5 per pound.*

New Magnesium Isotope Follows Plant Synthesis

Radioactive Atoms Probe Life Secrets

➤ A NEW RADIOACTIVE chemical, magnesium 28, has been created by Dr. Raymond K. Sheline of Florida State University, Tallahassee, with the aid of the University of California cyclotron and the University of Chicago betatron.

This new radioactive isotope of magnesium is considered particularly important because of its long half-life. Magnesium 28 has a half-life of 21.3 hours, more than 100 times that of the longest magnesium radioactivity heretofore found, which was a mere 9.6 minutes.

The long half-life means that scientists can learn more about plant and animal life processes with the aid of the new radioactive metal.

Dr. Sheline and associates are already using it to learn more about photosynthesis. This process of formation of sugars and starches from carbon dioxide and water under the influence of light takes place in the chlorophyll tissues of plants. And chlorophyll has magnesium in its molecule. How the magnesium gets into the molecule, since this only takes place in the plant tissue, is a puzzle Dr. Sheline hopes to solve through tracer studies with magnesium 28.

The new radioactive magnesium can be made either by bombarding elemental silicon in the betatron or, fairly simply, by bombarding metallic magnesium with alpha particles in the cyclotron. The targets after bombardment are shipped by air to Dr. Sheline who performs the chemical separation to get the new radioactive magnesium for tracer studies.

Diabetes Research

➤ TWO NEW radioactive chemicals, one of them adrenalin, are now commercially available for use in research on such ills as blood pressure and diabetes.

Made for the first time by chemists at Tracerlab in Boston, the two compounds can be traced in their course through the blood stream by the beta rays they emit. Quantities as small as a millionth of an ounce can be picked up by delicate research instruments.

Besides adrenalin, the other radioactive chemical is alloxan-2-C-14, which can be used to induce artificial diabetes in animals.

Study Embryos With CO_2

➤ RADIOACTIVE carbon dioxide is being used as a new tool to study the origin and development of certain organ rudiments in the embryo. The study is being performed by Dr. Reed A. Flickinger, embryologist of University of California at Los Angeles.

The investigation involves diffusion of radioactive carbon dioxide through the membranes of frog eggs. In this manner carbon compounds in the embryo are tagged so that their activity can be traced.

The study is particularly aimed at the tissue layers from which the organ

systems evolve. Present research is concerned with anaylzing the stimulus necessary for formation of the nervous system. It is suspected that the contact of tissue layers and a relationship between the life processes of the layers may be the key to this stimulus.

By tracing the activity of components of the tissues, made radioactive by contact with the radioactive gas, it is hoped some clue may be gained to the method by which such complex systems are fashioned from undifferentiated layers of tissue.

Chemical Fights Cancer

➤ TREATMENT of cancer patients with the radiations from cesium 137 is being planned at the University of Michigan's Medical School at Ann Arbor. At only one other place in the country, Oak Ridge, Tenn., will a cesium source be used to aid the fight against cancer during the next few years.

The radioactive cesium, a by-product of the uranium fission process in the pile at Oak Ridge, has to be separated from the other radioactive substances produced, so only a limited amount is available. If the cesium treatment is successful, however, it would mean the addition of a valuable source of high-powered, long-lived radiation to the anti-cancer arsenal.

Results of the cesium therapy will be compared with those from X-ray and cobalt-60 treatment, Drs. Fred J. Hodges and Isadore Lampe of the University report. In the Atomic Energy Commission's research on cesium therapy at Oak Ridge, the radioactive source will be rotated about the patient.

White Cells Tell Exposure

➤ A PRACTICAL, sensitive test for exposure to very small amounts of dangerous rays from atom-smashng cyclotrons can be made by examining the white blood cells called lymphocytes.

Ordinarily these cells have only a single nucleus each. But the radiation from the cyclotron causes a change so that lymphocytes with two-lobed nuclei appear in the blood. Scientists at the University of Rochester's School of Medicine and Atomic Energy Project discovered this in the early days of operation of their cyclotron.

The finding was confirmed in two "incidents" since then. In one, four physicists were in the cyclotron building when the man at the control panel made certain adjustments that made possible some slight exposure of the physicists to the beam. In the other, two machinists by mistake got within 50 feet of the cyclotron building while the atom smasher was running. This was before an earth and concrete dike around it had been finished.

Lymphocytes with bilobed nuclei appeared in greater numbers than normal in the blood of all six of these persons for a few weeks after exposure to the radiation from the cyclotron.

Increased numbers of white blood cells of this kind may also appear in germ diseases and in leukemia, but the four physicists and two machinists were not suffering from such diseases at the time their blood showed lymphocytes with bilobed nuclei.

Because these cells appear as a result of exposure to exceptionally small amounts of radiation, the University of Rochester scientists believe this

kind of blood test is a valuable addition to physical monitoring, such as badges which show exposure to radiation.

Reporting the studies are: M. Ingram, M. Adams, L. Coonan, J. Jespersen, G. Nielsen, D. Piatt, and G. Yettewich.

Resistance to Leukemia In Mouse Milk

➤ LEUKEMIA, cancer of the blood, is influenced, in mice at least, by a maternal resistance factor, or MRF.

This was reported by Dr. L. W. Law of the National Cancer Institute, Bethesda, Md., to the New York Academy of Sciences conference on parental age and characteristics of the offspring.

The leukemia-resistance factor is contributed both before birth and through the mothers' milk by the mother mouse low in tendency to get leukemia, Dr. Law said. However, no factor that tends to bring on leukemia, similar to the factor in the milk of mother mammals that is tumor-inducing, has been found in the low-leukemia mice.

Repressuring Gas For Oil Fields

➤ INERT GASES, made by burning the corrosive natural gases discharged with the oil from fields in Montana and Wyoming, are being successfully used underground to aid the flow of the crude in the oil-bearing strata to the wells which remove it by pumping.

The natural gases from oil fields in Park County, Wyo., and Carbon County, Mont., contain too much hydrogen sulfide to permit them to be used for underground pressuring. After the natural gasoline, liquid petroleum and elementary sulfur found in them are removed, and the remaining gas burned, the product is suitable for use because it is harmless to oil-bearing strata and to well and pumping equipment.

In several oil fields in the United States the natural gas coming to the surface with the petroleum can be put back in the underground formations from which it came to help increase the oil production. In other fields air or water is used for the same purpose. Ordinary pumping recovers only perhaps one-third of the underground oil. When a fluid under high pressure is pumped down a central well into the oil-bearing formations, a large additional amount of petroleum is recovered.

Gas produced with the oil in the Elk Basin field in Wyoming contains approximately 13% hydrogen sulfide and 6% carbon dioxide. This unusually high concentration of hydrogen sulfide makes the gas extremely poisonous. Air cannot be used to provide the pressure because the mixture with hydrogen sulfide would be highly corrosive. The solution, according to the U. S. Geological Survey, was found in burning the natural gas to obtain the inert gaseous products which are suitable for injection and at the same time have a larger volume than those consumed.

For The Home Lab

Sodium

by Burton L. Hawk

➤ My first experience with the metal sodium was quite an event. I had often heard of this amazing metal that could be cut like putty and would not only float on water, but actually dissolve in it and under certain conditions be made to *burn* in it! I could hardly wait to secure a small quantity of the metal and see these unusual reactions myself.

We are so familiar with the properties of metals like iron, copper and aluminum that when we consider sodium it is hard to conceive that it is a metal. Yet, in a chemical sense, sodium is more metallic than iron, copper or aluminum. When freshly cut it has the appearance of silver. It is soft and light in weight, melts at 97.7°. It is extremely active and tarnishes rapidly on exposure to air. Hence it must be kept immersed in a liquid which contains no oxygen, such as kerosene or naphtha.

You can well imagine that such an active metal would never be found free in nature. The compounds of sodium were known for centuries before the metal was ever obtained. Chemists were familiar with sodium hydroxide but they did not know its composition. Some thought it was an element, others thought it was a compound of nitrogen. All efforts to decompose it had failed. Then the new science of electro-chemistry came into being. Sir Humphry Davy, one of the foremost experimenters in this field, first tried to decompose aqueous solutions of the caustic alkalies. He succeeded in decomposing the water but not the alkali. Next he tried to decompose fused potassium hydroxide with his battery. In this he was successful and was the first person ever to isolate the metal potassium. A few days later he tried the same experiment with sodium hydroxide to isolate sodium.

The discovery of sodium and potassium aroused the public interest in a dramatic manner—probably much in the same way that the sulfa drugs and penicillin have done in our time. Practically every chemist was interested and attempted to prepare the wonder metal in his own laboratory. The famous chemists Gay-Lussac and Thenard prepared the alkali metals without electricity by reducing the hydroxide with metallic iron at a high temperature. Another famous chemist, Friedrich Wöhler, also isolated potassium without an electric current by heating potash and charcoal to white heat in a graphite crucible.

You can purchase sodium metal from a chemical supply house. It is not expensive, and one ounce will be plenty for these experiments. Be sure the metal is kept under oil, kerosene or naphtha at all times. Do not handle it with your bare hands.

Cut a piece of sodium the size of a pea. Note the shiny luster as you

cut it. Press the metal gently between blotters to remove excess oil, then drop it into a large pan of water (such as a cake pan). It will zig-zag rapidly in all directions over the surface of the water until it is dissolved. Keep your face away. Often after the sodium has apparently all dissolved, there is a final loud "pop" as the last particle explodes. Wait for this "pop" before you get too close. The water in the pan is now sodium hydroxide, as you can prove by adding a few drops of phenolphthalein solution. Or, for a little novelty to the above experiment, add the phenolphthalein first, then drop in the metal. As it dissolves, the water turns pink.

Now place clean water in the pan, moisten a piece of filter paper and allow it to float on the water. Drop a *small* piece of sodium metal on the paper. The metal will ignite with a bright yellow flame. This floating flame provides an unusual effect. Again, wait for the final "pop" before approaching the pan.

Sodium is a powerful reducing agent. Cut a few very small pieces of the metal, dry carefully, and mix with one gram of copper oxide in a porcelain crucible. Place a lid on the crucible and heat gently. The action may be somewhat violent, so use caution. After all action ceases, remove the lid and see if you can find any pieces of metallic copper. We obtained several metallic balls the size of a pin head by this method.

Sodium combines directly with many elements. For example you can prepare synthetic salt. Place a dry, freshly-cut piece of sodium in a dry deflagration spoon and lower into a jar of chlorine gas. Allow it to remain in the jar for about thirty minutes. Upon examination, you will notice the formation of a white powder, which is common salt. (Better not taste it!) The reaction is simply a direct union of two elements: $2\ Na + Cl_2 \rightarrow 2\ NaCl$.

Sodium unites with mercury to form the *amalgam*. Place a small drop of mercury in a mortar. Cut a still smaller piece of clean dry sodium into very small particles. Add to the mercury and press the two elements together with the pestle. You will hear miniature explosions as the amalgam is formed. As with the metal itself, sodium amalgam is decomposed by water with the evolution of hydrogen.

Sodium melts easily as can be demonstrated by heating a small piece in a porcelain dish. It will burn in air with its characteristic yellow flame.

Sodium metal is quite useful in the preparation of many sodium compounds, such as the peroxide, azide, etc. It is used to produce the important tetraethyl lead, in various organic reactions and in sodium lamps and photoelectric cells.

Plant science has enabled this nation not only to maintain the level of wheat production but to build up yields in the face of declining soil fertility and increasing damage from insects and diseases.

Phenobarbital, dilantin, tridione, mebaral, and phenurone are among the drugs which reduce the number of attacks and help epileptics lead useful lives.

Tremendous Temperatures of the Corona Strip Electrons From Iron and Calcium

The Sun's Atmosphere

A summary of the Sigma Xi Lecture delivered at a series of universities during the month of March, 1953, by Dr. Walter Orr Roberts, superintendent of the High Altitude Observatory of Harvard University and the University of Colorado, at Climax, Colo. The title of the lecture is "Unsolved Problems of the Sun's Atmosphere."

➤ FOR MANY centuries, men have acknowledged gratefully the life-giving bounty of the sun's radiation. In many religions, going back even to the threshold of history, the sun has been an object of veneration. And for generations men have sought to understand the mechanisms by which the generous supply of radiation of the sun is sustained. Much of our knowledge about the physics of the sun has come from the fleeting moments of total eclipse of the sun, when the tenuous solar atmosphere bursts into visible radiance. But in spite of the vast growth of our knowledge, the steady succession of solar eclipses has brought new unsolved problems in ever-increasing array. As our areas of knowledge enlarge into the space of the unknown, the domain of our ignorance expands steadily beyond. By examining the unsolved problems of the sun's atmosphere, we can plot the direction of our progress, and can foresee something of the rewards that await us as the problems gradually yield to our analysis.

Once a year, on the average, a total solar eclipse occurs somewhere on the surface of the earth. The eclipse, of course, may take place in remote regions of the earth's watery surface, and it may be most difficult for scientific expeditions to establish themselves within the narrow path of totality of the eclipse. Even after reaching the path of totality, the scientists who go to the eclipse may find their efforts frustrated because clouds blot out the sun during the brief few minutes of totality. In spite of all of these shortcomings and limitations, a great part of our knowledge of the behavior of the energy-giving sun has come from eclipse observations. The reason for this is that during total eclipse certain features of the sun's atmosphere—the prominences and the corona are the most important of these—become spectacularly visible. These features are for the most part transparent, and it is possible for astronomers to learn a great deal about the nature of the forces and of the physical conditions of the surface of the sun from study of the prominences and corona. Also as knowledge of the radio effects of the sun has grown, and as we have enlarged our experience with the small changes of cosmic ray radiation falling on the earth, we have found important new phenomena that seem to be controlled by behavior of the sun's atmosphere itself, rather than exclusively by the surface or interior behavior of the sun.

The great value of eclipse observation has led astronomers down through the years to try to measure the same phenomena without waiting for a natural eclipse. Telescopes designed for the purpose of taking artificial eclipse pictures have been built and tested with varying degrees of success for at least a century. The first really promising success came in 1868.

Janssen and Lockyer, in that year devised, independently, an entirely new spectroscopic technique for revealing the gaseous hydrogen prominences without natural eclipse. They showed that the enormous solar prominences seen at eclipses are gaseous, and that they move with incredible velocities in a way difficult to explain. Their work presaged the advent of the first crude forms of the spectroheliograph, today one of our most important instruments for observing the sun's face and atmosphere. By this step, they became the first to make successful observation of the eclipse features of the sun by artificial means.

In the years following their work, such people as Deslandres, Hale, and others vastly improved the early techniques. At the present time several observatories scattered throughout the world operate spectroheliographs of high quality, and with these instruments astronomers are able to study, among other things, the behavior of solar prominences, the irregular giant clouds of hydrogen and other gases that jut so spectacularly from the sun's limb during total eclipse.

The highest development of the spectroheliographic technique has taken place at the McMath-Hulbert Observatory in Michigan. Dr. Robert R. McMath, director of this observatory, has combined the spectroheliographic technique with motion picture practices. The result has been rapid sequence photographs with the spectroheliograph, suitable for projection as motion pictures. By these means information has been found that it would have otherwise taken much greater labor and much longer periods to discover.

Another entire line of development based in part on the spectacular success of Janssen and Lockyer, has come with the development by the French astronomer Lyot of the solar coronagraph and the birefringent filter. Astronomers now use these devices at a half-dozen observatories to observe daily variations of many different parts of the sun's atmosphere, including particularly the emission lines of the sun's corona, the faint diffuse halo seen completely surrounding the sun at total eclipse.

From observations of the sun and its atmosphere made with the powerful instruments of modern astrophysical stations, astronomers probe the many enigmas of the sun's behavior. For example, one of the major unsolved problems of the sun is that of the mechanism by which the million-degree ionization of the corona is sustained. The brilliant theoretical researches of Edlen of Sweden, about a decade ago, led to the knowledge that the emission lines of the sun's corona originate in extremely highly ionized atoms, such as FeX, FeXIV, and CaXV. By what means have these atoms been stripped of the large number of electrons they have lost? And by what means are the atoms continuously supplied to the corona? Does the coronal material come in from

outer space as suggested by Hoyle, or does it rise in some invisible form from the surface or from the interior of the sun as Menzel believes?

Or to turn to another major unsolved problem of the sun: by what method are the giant hydrogen prominences supported against the intense gravitational forces of the sun. The force of gravity at the surface of the sun exceeds terrestrial gravity by about 27 times. Yet the prominences are somehow supported in delicate equilibrium against this potent force of gravitation. What forces are counterbalancing the gravitation? Milne and others have suggested that the forces may be "radiation pressure," the same force that keeps the tails of comets pointed away from the sun. But severe difficulties face the suggestion because if this were the case the chemical composition of the prominences should be very different from what it is. Others have suggested that in some way the prominences are entrapped in the magnetic field lines of the sun's magnetic field, and the intense magnetic fields of sunspots. In fact the very nature of the mechanism by which the magnetic fields themselves are sustained is quite a mystery. There is no direct evidence for the giant currents necessary to explain the fields in ordinary terms, and it seems unlikely that any sort of permanent magnetism of the type so familiar on earth can occur on the gaseous sun.

Solar "flares" are among the most spectacular of the forms of behavior of the sun. Occasionally these flares, like giant explosions, burst out and cover an area measured in hundreds of thousands of square miles, with intensely brilliant radiation in H-alpha. Presumably associated with the flares are tremendous bursts of ultraviolet radiation that produce spectacular effects in the upper atmosphere layers of the earth upon which we depend for long distance radio communication. And perhaps even the entire question of the origin of terrestrial storms is tied up with the action of the flares in heating the ozone layers of the terrestrial atmosphere. Dr. Richard Craig, formerly of Harvard and now with the Air Force Research Center at Cambridge, has, for example, found a very suggestive statistical relationship between the outbreak of solar flares, and changes of barometric pressure in the earth's atmosphere.

Not only does the sun occasionally give vent to the violent luminous radiation accompanying solar flares, but also radio research has disclosed that when a selective radio antenna is pointed at the sun, it occasionally receives strong outbursts of solar radio static. The radio frequencies involved lie in the vicinity of 200 mc/s, and even higher frequencies. The nature of the physical mechanism producing the outbursts is quite a mystery. But the outbursts are of considerable importance, for they occur in the same range frequencies used for radar work, and the bursts of static of these frequencies can do damaging things to the effectiveness of radar. Excellent preliminary analysis of the movement of the sources of radio static across the face of the sun is being done, particularly by research workers in Australia. It seems quite likely that these sources of radio static will turn out to be associated in some way with the spectacular atmospheric eruptions observable by spectroheliographs, birefringent fil-

ters, and the other devices developed by astronomers for artificial eclipse observation of the sun.

Then too we have the whole area of the effects of solar corpuscles emitted from the sun upon the magnetic and other conditions of the earth. The mysterious "northern lights" so frequently seen at high latitudes in the United States almost certainly originate in streams of particles—probably protons and electrons—coming from the sun. Yet direct observational evidence for the emission of these particles from the sun is still lacking. The corpuscular showers may be directly related to the emission of the high energy particles that we recognize as "cosmic rays." Thus it may turn out that a substantial part of our "cosmic" rays actually are not cosmic in origin in the usual sense, but come instead from our own nearby star, the sun.

To all of these studies the High Altitude Observatory, with its coronagraph station at Climax, Colorado, is making its modest contribution. From this station have come long-sustained series of observations of the sun's corona leading, among other things, to discovery of a new relationship between the corona and the earth's magnetism, and to new clues to the physical origin of the corona and prominences. Also from it have come measurements of a new type of tiny solar prominence known as a "spicule" which shows some promise of contributing substantially to the maintenance of the sun's corona and ordinary prominences. Powerful new coronographs will soon aid the High Altitude Observatory in its part of the world-wide assault of astronomers upon the unsolved problems of the sun's atmosphere.

Glycol Motor Oil For Arctic Weather

➤ NEW SYNTHETIC motor oils that lubricate truck and automobile engines satisfactorily, even under Arctic conditions, were described to the fuels and lubricants conference of the Society of Automotive Engineers at their meeting in Tulsa, Okla.

J. A. Miller and H. F. Galindo, both of the California Research Corporation, Richmond, Calif., reported that synthetic oils made of polypropylene glycol give excellent performances in Alaska, Canada and the coldest parts of the United States where temperatures often plunge to minus 35.

Even in the coldest weather, the new synthetics remain fluid enough to permit the engine to be started easily. They have the advantage also of not boiling away rapidly after the engine reaches its normal operating temperature of about 180 degrees.

Military requirements are demanding new and better oils for use in cars and trucks in the Arctic. Present make-shift methods of getting sluggish engines started often result in damaged vehicles.

The synthetic oils can be made from materials readily available, with no major troubles of manufacturing. Although somewhat more expensive than mineral oils, they are relatively cheap when compared to other synthetics having the same properties.

How the Molecular Structure Of Insulin Was Determined

The Structure of Insulin

Reprinted from the Journal of the American Medical Association

KNOWLEDGE of the chemical structure of biologically important compounds is desirable not only for use in their possible synthesis or chemical improvement but also for a more complete understanding of their precise function in the organism. One of the most widely studied substances in this category is insulin. Many attempts have been made to elucidate the chemical nature of this hormone since its successful preparation some 30 years ago. It was soon found that insulin was a protein and hence was undoubtedly an extremely complex substance from a chemical standpoint. This was substantiated by the finding that insulin had a high molecular weight, characteristic of proteins, and that it contained nearly all of the amino acids found in most proteins with the rather remarkable exception of tryptophane, methionine, and hydroxyproline.

The recent development of greatly improved techniques for separating closely related chemical compounds by chromatography and by countercurrent extraction has opened a new approach to the study of the structure of complex compounds such as proteins. One group of workers at Cambridge University in England under the direction of Dr. F. Sanger has applied these techniques to the determination of the structure of insulin. First, a new procedure for determining the terminal free amino groups of insulin was devised. The procedure involved treating insulin with 1:2:4 fluorodinitrobenzene (FDNB), which formed on the terminal free amino group a 2:4 dinitrobenzene derivative that was stable to acid hydrolysis. The insulin was then hydrolyzed, the 2:4 dinitrophenyl amino acid derivative was separated by partition chromatography, and the amino acid itself identified by chromatographic comparison with known amino acids. In this way it was found the insulin molecule had four terminal free amino groups, two of which were from glycine and two from phenylalanine. Further studies in which insulin was oxidized also indicated that the molecule contained two identical pairs of peptide chains.

The elucidation of the amino acid composition and sequence in each of the two pairs of peptide chains was next attempted in an ingenious manner, insulin was again oxidized and separated into the two types of peptide chains. The peptide chains were then partially hydrolyzed into smaller peptides, usually of two or three amino acids each, by acid or by proteolytic enzymes. The smaller peptides were separated by chromatography, and their amino acid composition was determined. By determining the amino acids present in the many smaller peptides, Dr. Sanger's group was able to piece together the amino acid sequence in the entire peptide chains of both types and thus establish not only the identity of all amino acids

comprising the insulin molecule but the sequence in which they occur. Today insulin thus appears to be a protein with a basic molecular weight of approximately 12,000 and to be comprised of two pairs of peptide chains joined together by sulfur to sulfur linkages fom cysteine. One type of peptide chain contains phenylalanine as the N-terminal amino acid and is composed of 30 amino acids in known sequence; the other two peptide chains contain glycine as the N-terminal amino acid and are composed of 21 amino acids of known sequence. The foregoing series of monumental investigations is noteworthy too in that they are perhaps the first to completely elucidate the structure of so complex a chemical substance as a protein.

—Dale McFeatters

➤ Lot of *activity in International Oil today!*"

The Impact of Petroleum On Our Civilization

Modern Living Needs Oil

by Dr. Gustav Egloff
Universal Oil Products Company

An address in acceptance of the Washington Award of the Western Society of Engineers, 1953, Chicago, Illinois.

➤ Petroleum is essential to all phases of modern living. Our civilization would come to a stand-still without oil. Petroleum is not only our primary energy source but also the source of raw materials for about 5000 different products. The industry has always been at the forefront in making new and improved products at a lower cost to the consuming public. It is our third largest industry with total investments of $43 billion, and it employs over 2 million persons. Only agriculture with investments of $170 billion and public utilities with $52 billion are larger.

These gigantic proportions have been attained in the relatively short period of 94 years since the discovery of the Drake Well in 1859. The present magnitude of the petroleum industry is the result of its attitude toward investment and research. Since World War II, it has spent $20 billion in expanding and improving its facilities, and plans to spend $4 billion more during 1953. These expenditures enable the industry to meet all demands and keep pace with technical advancements in exploration and drilling equipment, refinery units and transportation facilities. Increasing amounts are required for many of its operations. For example, the cost of drilling a well has increased 200 per cent in the last five years. One of the principal reasons for increased cost is that the oil being discovered is at greater depths or otherwise less accessible than formerly. The willingness of the oil industry to invest in the future is perhaps more clearly illustrated by the cost of $1,250,000 which is required for a single man-made island in the drilling on an offshore well in the Gulf of Mexico.

Despite the increasing costs which the industry encounters, it maintains gasoline prices at a much lower level than those of other commodities and at the same time, pays its workers high wages. The price of gasoline, including taxes, has risen an average of about 45 per cent over the past thirteen years compared to about 85 per cent for all commodities.

The primary reason behind the ability of the petroleum industry to spend more without raising prices correspondingly is its extensive utilization of engineering and scientific manpower. It employs over 17,000 college trained engineers and scientists and spends over $130 million per year on research. The inventions which result therefrom enable the industry to offer new and improved products and at the same time, keep costs down. Furthermore, the value of inventions steming from petroleum research has extended far beyond the industry it-

self in the application of techniques and instruments to other industries. For example, the fluid technique for handling solids, which was developed in connection with the Fluid Flow Catalytic Cracking process, has been applied to a wide range of procedures such as the recovery of metal from low grade ores, the manufacture of phthalic anhydride, and the burning of limestone. Another illustration is the use of hydrogen fluoride as a catalyst in the alkylation process which is used for aviation gasoline components. Hydrogen fluoride has some violently corrosive properties which at first seemed to preclude its commercial use. The difficulties were overcome and thus all industry was provided with the know-how to use this substance.

The petroleum industry also increases the volume of business of other industries. As one illustration, the requirements for cracking catalysts are about 1,000,000 pounds per day, and when scheduled expansion is completed will reach about 1,400,000 pounds per day.

The ability of the industry to cope with the seemingly impossible has very frequently been evident during emergencies. The sudden need for unprecedented quantities of 100-octane aviation gasoline during World War II brought about rapid commercialization of new processes. Even before Pearl Habror, large volumes were supplied to the Allied nations. The greater power and maneuverability of planes fueled by 100-octane gasoline enabled British fliers to turn the tide of the Battle of Britain against the Nazi air armada which ran on 91-octane fuel. The high requirements for TNT and synthetic rubber were met by an almost over-night commercialization of processes that had been under study for production of toluene and butadiene. One of the most remarkable engineering achievements, the construction of the "Big Inch" pipe line, was another wartime challenge which the industry had to meet to insure the transportation of oil from the Gulf Coast to the East Coast as it was being cut off by submarine attacks on tankers. At the start of the Korean War, the United States was threatened with a crippling shortage of benzene which is basic to many kinds of plastics, synthetic rubber, nylon, detergents and other materials for both defense and civilian needs. Previously the entire production had come from coke ovens, the operation of which is tied to steel production. In the short space of time intervening, the petroleum industry has become a large scale producer of benzene and the shortage has been alleviated.

The petroleum industry enters into so many phases of our lives that only a few of its effects can be considered in detail. Petroleum (this term as used here and subsequently includes natural gas) is most important as a source of energy for transportation, heating, and industrial operation. Since World War I, it has been assuming the additional load imposed by our rapidly increasing energy requirements and has displaced coal as a primary source. During this period, coal production has been almost static at about 610 million tons per year. In contrast, petroleum production has increased over six times and natural gas five times. They now furnish 57 per cent of our energy requirements

while coal furnishes only 39 per cent and water power the remaining 4 per cent. Although the increase in automobiles, trucks, busses, and aircraft is a major factor in this shift in energy sources, the conversion from coal to oil in power generation and industrial and household heating and the replacement of coal burning locomotives by diesels have also been of great importance. These changes have brought about many benefits to consumers because of the greater convenience in handling, ease of control and cleanliness.

Gasoline is today the largest volume product of the industry but it has not always been. From 1859 to about 1915, kerosene was produced in greater quantities than gasoline. The revolution from a kerosene to a gasoline producing industry is one of the greatest achievements in our history and the one which has literally put America on wheels. When the automobile first came into use, 13 per cent was the maximum amount of gasoline obtainable by distillation of crude oil, the only refining process that had been developed. By 1910, there were 500,000 automobiles and progressively minded oil men began to realize that much greater quantities of gasoline would be needed than could be provided by merely increasing production of crude oil.

Petroleum researchers, however, were already at work on the gasoline problem, and in 1913, the first commercial cracking units went into operation. Improvements in cracking were soon forthcoming with the result that there has always been more than enough gasoline of sufficiently high quantity to meet the requirements of our ever-increasing number of automobiles.

In the middle 1930s, catalytic processes began to come into commercial operation. The effect of these was to make much higher octane gasoline available and to increase quantities so that about 45 per cent of gasoline is now obtained from crude oil. The use of cracking processes makes unnecessary the production of about 2.5 billion barrels of oil per year which would otherwise be required. Increased yields of gasoline are not the sole factor in the conservation of oil. Improved quality results in increasing mileage. Two gallons of today's gasoline is equivalent to three gallons of 1925 gasoline. In fact, the high compression auto engines of today could not even run on 1925 gasoline. Even greater savings will be made when the 12:1 compression ratio engines are in use and higher quality gasolines can be used. Road tests show that they get 40 per cent more miles per gallon than today's automobiles.

Likewise, modern aviation would not be possible without the high octane aviation gasoline which has resulted from continuous research and development. By use of new and improved processes, the industry produces gasolines which exceed the octane scale and a new scale of performance ratings has been set up. Although octane number is a major criterion in measuring the quality of gasoline, other factors are of high importance and continuous research relating to them is carried on.

Jet planes have posed new and entirely different problems from those associated with reciprocating engines. Initially, the jets required about five

times as much fuel. This and other problems have been partially solved, but tailor-made fuels for jets can be expected.

Still different criteria of quality are encountered in diesel fuels and demand has been rising rapidly. One of the main reasons for the rise is that about 70 per cent of the total passenger and freight miles are now run by diesels. Another product for which demand has risen is light heating oil, used principally for household heating. Oil and natural gas heating have become very popular because of the advantages in cleanliness, easier regulation and less manual labor compared to coal. In 1935, coal furnished 80 per cent of the heat for buildings while oil and gas furnished only 19 per cent. In 1951, coal utilization had dropped to 43 per cent while oil and gas had risen to 54 per cent.

Other time-honored petroleum products include lubricants and waxes. The industry now makes over 1500 different lubricating oils and 430 greases. Although petroleum greases were used on the wheels of grandma's buggy and her apple jelly was sealed with paraffin wax, the petroleum waxes and lubricants of today encompass products for widely divergent purposes ranging from giant machines to tiny watches.

The petroleum industry, however, is now much more than a producer of motor and heating fuels and lubricants. It is the foundation for a vast new chemical industry. Starting as a by-product outlet about 30 years ago, petrochemicals have grown into a $2 billion dollar industry. At present, it is producing over 25 per cent of the total chemical requirements of the United States and will be producing 50 per cent of the total by 1962. The development of this industry has made possible greater quantities of old products and some entirely new products which add greatly to the convenience of living. The opportunities for the future in this field are limitless. With ample raw materials to depend upon, research can go forward to enhance the standard of living of the entire world.

Petrochemicals include many products for which demand is a billion pounds per year or more. They include both chemicals such as methanol which were formerly produced entirely from other sources and those such as isopropyl alcohol which have been made possible only by utilization of petroleum as raw material. Methanol is commonly known as "wood alcohol" but many years have passed since it was actually derived from wood and natural gas is now the chief raw material. The principal use of isopropyl alcohol is in the manufacture of acetone, another product once derived entirely from non-petroleum sources. These changes in raw materials are important not only because of lower costs but also because sufficient quantities of chemicals to meet present requirements could not be produced from the former source materials.

The end products which are now available from petrochemicals are revolutionizing many phases of our living. The most important of these are the chemicals used for plastics, synthetic rubber and textiles.

The plastics are replacing scarce metals, glass, ceramics, wood, natural fibers, leather, paper and other ma-

terials. In many cases, they are superior to the material which they replace, and very often are less costly. One of the most recent replacements in the metals field is the use of plastic pipe lines. They have the advantages of being flexible and resistant to corrosion, scale and rust, and having lighter weight. Another metals replacement which will soon be in mass production is in auto bodies made from resin-laminated glass fiber. These bodies will not dent nor rust, they are strong but light in weight and therefore save gasoline and cut down on tire wear. A similar material will be used for the fabrication of bath tubs. These will be particularly advantageous for use in trailers where weight is an important factor. The resin-glass fiber tubs weigh about 15 pounds compared to 150 pounds for enameled steel and 300 pounds for enameled cast iron tubs.

It is an interesting observation that the revolution in materials involves not only the use of entirely new substances but more advantageous utilization of such time-honored material as glass. While glass fibers are superior to metals and textiles for some purposes, plastics are replacing glass in some of its former uses. Polyethylene, for example, has many advantages over glass in bottles for cosmetics, pharmaceuticals and many chemicals. The polyethylene bottles are unbreakable, lighter in weight and resistant to most chemicals.

In the household, plastics have an extraordinary range of applications. It is believed that vinyl floor coverings will outlast the houses in which they are laid. Furthermore, these coverings need never be waxed or scrubbed and they do not stain or decompose from contact with grease. Plastics have also made vast inroads into the paint market. Replacing vegetable oils as base for paints to be used on interiors, they are easier to apply, eliminate odor, and dry more quickly. New packaging films made from polyethylene or Saran preserve food longer and are usable for some purposes such as deep-freezing for which the older type films were unsuitable. Plastics are also used in rust-proof screens, parts for radios and refrigerators, unbreakable dishes, decorative pieces and other household articles.

The industrial implications of plastic developments are far-reaching. One of the best examples is the replacement of sand molds by phenolic shell molds in foundries. The new shell molds produce castings with smoother, more accurate dimensions and require less machining than those from conventional molds. The lighter weight of the sheet molds makes possible the employment in foundries of persons having less physical strength than was previously necessary. Requirements for phenolic plastics for this purpose are expected to rise from a total of about 3 million pounds last year to 80 million within five years.

The new textile fibers are perhaps the most interesting of all of petrochemical-based products. Chemically, they are closely related to plastics and some of them could be classed in either category. In general, they have advantages over natural fibers in being stronger, faster drying, requiring little or no pressing, resisting deterioration from moths, mildew and chemicals. As a consequence, they require less care and wear longer. They are

produced from raw materials which are not subject as are natural fibers to such unpredictable factors as weather conditions, ravages of insects, and health of animals. As a result, everyone should some day be well clothed and housed in attractively decorated quarters.

The individual fibers vary in their applications and for some uses are blended with natural fibers. Nylon is well-known but additional uses are continually being found. One of the most dramatic is as material for armored vests. Officials have credited these vests with reducing chest and abdominal wounds by 60 per cent in Korea. Another less known use of nylon is in rugs which will outwear wool by at least five times. They dye uniformly, can be matched while wool fibers vary, and can be cleaned with soap and water. Nylon, of course, is no panacea. Men's shirts, for example, were not too popular, but another fiber Dacron has since been developed for shirts and has in addition to the quick-drying advantages of nylon, better appearance, greater comfort, and no pressing requirements. Dacron is also being used both alone and in blends for suiting fabrics.

The acrylic fibers, Orlon, Dynel and Acrilan are used principally as replacement for wool, either alone or in blends with wool, cotton or rayon, in such products as blankets, curtains, socks, shirts, work clothes, underwear, suiting, dresses and industrial fabrics. Acrilan has the greatest tensile strength and Orlon is the most resistant to atmospheric deterioration. Dynel is the most flame-resistant and for this reason over 13.5 miles of it were used for draperies, blankets, bedspreads and trim on the new ocean liner, the United States.

The vinyl yarns, Saran and Velon, have been used most extensively for auto seat covers. Recently, however, a wide variety of textile products ranging from rugs to clothing have been produced.

Closely related to synthetic textiles and plastics is synthetic rubber. The rubber industry as we know it today could not exist without petroleum as source material. The effect of petroleum-derived rubber has been to put the United States in a position of self-sufficiency in so far as rubber supplies are concerned. Continuous research is resulting in greatly improved types of rubber. The development of cold rubber, for example, has increased mileage of tires made from it by 25 per cent and has thereby saved the public about $347 million during the past year. Many specialty rubbers have also been developed for inner tubes, heavy duty electrical insulation, hoses for gasoline pumps, self-sealing gas tanks, and other purposes. One of the most vital roles of petroleum products is in agricultural production which has been increased by the use of petroleum-fueled machines and such chemical products as fertilizers, insecticides, fungicides, growth-regulators, weed killers and defoliants. The impact which these innovations have had is illustrated by the radical change from 1910 when farm workers constituted 31.0 per cent of the labor force to 1952 when only 13.9 per cent were thus employed. The per acre yield of corn, our most important crop, has been raised over 35 per cent during this same period by the combined effects of mechanization, hybridiza-

tion, and the use of chemicals. The application of the weed killer 2,4-D is a good illustration of the savings made. Weeds can be eliminated by the application of one pound of 2,4-D per acre and this operation takes only one hour with a tractor-drawn power sprayer as compared to 100 hours of manual weeding. It has been estimated that corn production could be raised as much as 50 per cent by more widespread use of chemicals. Wheat production likewise could be increased by as much as 30 per cent without any increase in labor requirements.

Cotton requires at present the largest proportion of farm labor of any major crop. The use of machines and chemicals, however, is being rapidly increased. Airplanes are now used to cover some large areas with insecticides, defoliants, and other chemicals. Total mechanization and "chemicalization" would, according to estimates, reduce the number of man-hours required to produce one bale of cotton from 155 to 10 hours.

Despite the widespread use of machinery and chemicals, it has been estimated that $13 billion worth of crops are lost every year because of weeds, insects, fungi, and plant diseases. Petroleum will play a primary role in reducing this loss because it will be the major source of fuels for mechanization and chemicals for pest control.

These are but a few examples of the many products from petroleum. The myriad of chemical products, however, requires less than one per cent of the total U. S. oil production and about 5 per cent of the total natural gas production. The planned expansion of the industry assures ample supplies for expansion of present products and for manufacture of those which will be developed by our engineers and scientists.

This discussion of the impact of the petroleum industry has been limited to the United States, but its effects are world-wide. One of the most spectacular examples involves the use of a single petrochemical insecticide, aldrin, which is effective against such devastating pests as locusts, grasshoppers, and boll weevils. During 1951, Iran had its worst locust plague in 50 years and called on the United States for help. A team flew over from this country with supplies of aldrin and in four days time, the locust kill was 100 per cent and over 53,000 acres of crops were thereby saved. On a much broader scale, however, the United States petroleum industry carries out a privately financed point four program. Wherever our oil companies have operations, living conditions have been vastly improved, and good employment and educational opportunities have been made available to thousands of natives.

Fantastic as the achievements of the petroleum industry in the past may seem, they are only an indication of what is yet to come. The industry has the kind of faith in the future that has made America great and continues to hold even greater promise for our civilization.

Chemical sprays for blossom thinning, a post-war development in commercial orchards, are being used on an increasing number of apple trees.

New Chemical Materials Find Many Needed Uses

Patents of Chemical Interest

To obtain a copy of any patent, order by number from the Commissioner of Patents, Washington 25, D. C., enclosing for each copy ordered 25 cents in cash, money order or Patent Office coupon. Do not send stamps.

Titanium For Electrodes

➤ ELECTRODES made of titanium or tipped with titanium will stand up better in brazing operations than the older carbon electrodes, the inventor of a titanium electrode claims. Brazing is the joining together of two metal parts under heat and pressure by another metal with a lower melting point. Titanium can withstand both the heat and pressure better than can carbon, Ralph J. Bondley, Scotia, N. Y., claims. He has assigned his invention, patent number 2,629,803, to the General Electric Company.

Anion Exchange Resins

➤ Two ANION exchange resins, one weakly basic and the other strongly basic, have been patented. The resins are used for separating out one or more components of a chemical compound. Inventor is Jesse C. H. Hwa, Philadelphia, and he has assigned his patent to Rohm and Haas Co., Philadelphia. The weakly basic resin is made by reacting ammonia or a primary or a secondary amine with an insoluble, cross-linked polymer of a glycidyl ester of acrylic acid or of an alpha-substituted acrylic acid. The strongly basic resin is made by reacting, in aqueous medium, a tertiary amine with an insoluble, cross-linked polymer of a glycidyl ester of acrylic acid or of an alpha-substituted acrylic acid. Patent numbers are 2,630,429 and 2,630,427, respectively.

Plastic Helicopter Blades

➤ HELICOPTERS with plastic rotor blades may soon be flying through the air with the greatest of ease.

The patent, number 2,630,868, on a plastic rotor blade was granted to Francis R. Ellenberger, Cedar Grove, N. J., and assigned to the General Electric Company.

Mr. Ellenberger points out that the ordinary type of rotor blade has a longitudinal spar, sometimes used in combination with transverse ribs. His blade, shaped from a cellular plastic material, eliminates the expense and difficulties involved in building a rotor blade, requires less skill manufacturing and has more strength.

His blade carries nearly all the stresses on the outer skin, which is filled with a relatively weak cellular plastic material. This keeps the skin from collapsing and maintains the correct cross-sectional contour.

The plastic blades are formed by extrusion, molding or machining a piece of cellular cellulose material into a section of the desired airfoil shape, wrapping it with cloth impregnated with phenolic compound, clamping it in a mold and curing in an autoclave.

Fog Generator

➤ CITIES famous for "smog" may not want this invention but it has other uses. It is an artificial fog generator. The inventor, William J. Besler, Piedmont, Calif., claims it will be useful in time of war to cover movements of troops and in time of peace to spread insecticides. Patent number is 2,630,412.

Re-fillable "Bomb"

➤ A "BOMB" designed to be used either for insecticides or fire-fighting fluid has been invented. It can also be refilled at home. The bomb has a handle on it located so that when the fluid is emitted it is aimed directly away from the holder. Patent number is 2,630,942, and it is held by John E. Schaffer, Brandon. Fla.

Gas Turbine Autos

➤ AUTOMOBILES powered by gas turbine engines are envisioned by a British inventor. Horace S. Rainbow, Coventry, England, has patented such an engine which can be installed in the space normally taken up by the present type of engine.

His turbine provides a centrifugal compressor at the front delivering compressed air to a combustion chamber. The chamber is connected at its outlet end to a chamber which provides the products of combustion and air to an axial-flow turbine.

The invention, patent number 2,631,427, has been assigned to Armstrong Siddeley Motors, Ltd., Coventry.

RCA Color Television

➤ ONE OF the basic patents for RCA's system of color television was granted recently to Dr. Alfred N. Goldsmith. He assigned the patent, number 2,630,542, to RCA. This is a rival system to that put out by the Columbia Broadcasting System. The latter won approval from the Federal Communications Commission just before defense production forced a freeze on mass production of color TV sets.

The viewing face of the television screen is coated with 600,000 tiny phosphor dots. They are placed in groups of three, and one of these three is red, another blue and the third green. A shadow mask just behind the screen with 200,000 tiny perforations screens off the other two dots when it is necessary to excite, or light up, one of them. Thus the beam for exciting the red dot cannot hit the other two green and blue dots.

It is this shadow mask which is claimed in Dr. Goldsmith's patent.

Another Color TV

➤ TWO OTHER inventors have tackled the problem of blurred color TV pictures which they say is sometimes the result of purely electronic color television operations. Norman L. Heikes, San Francisco, and Robert J. Stahl, Redwood City, Calif., have invented a color TV camera in which an electronic scanning operation is attainable while still completely avoiding registration difficulties.

To accomplish this, a single image only is used for color analysis purposes and this image is passed through a suitable optical or color filter formed of a grid-like structure. Patent number is 2,630,485 and it has been assigned to Color Television, Inc., San Francisco.

Proudly Presented

➤ TRIOXANE, cyclic trimer of formaldehyde, in continuing commercial quantities, is offered by the Chemical Division of Celanese Corporation of America. It is a material with many uses. When molten it is an excellent solvent for many organic chemicals such as phenols, naphthalene, fatty acid amides, zein, urea, polyvinyl acetate, ethyl cellulose and celullose acetate. It is also used by the Government as the standard U. S. Army heating tablet, as it burns with a steady non-luminous flame which gives no harmful vapors or soot. Although highly stable, Trioxane must be kept in sealed containers to prevent loss by evaporation. It is packed in 20 and 55 gallon fiber drums. Data sheets giving complete specifications available on request to Celanese Chemicals, 180 Madison Ave., New York 16, N. Y.

➤ DEMINERALIZATION and silica removal through ion exchange resins has come into extensive use in industry, since its operating costs are much more economical than distillation of water. A new bulletin by the Permutit Co. describes the chief applications, principles of operation, design features, advantages, recommendations and specifications of their demineralizing and silica removal apparatus and synthetic resins. Write for Bulletin No. 3803, to the Permutit Co., 330 W. 42nd St., New York 36, N. Y.

➤ SAFETY CHARTS on a series of chemicals, giving description, safe methods of storage, usual shipping containers, safe practices and rules for handling have been issued by the U. S. Department of Labor. Chart No. 2 illustrates safe handling of hydrochloric acid, Chart No. 3 deals with ammonia, etc. The material in the charts is based on Chemical Safety Data Sheets and other publications of the Manufacturing Chemists' Association. The charts are published by the U. S. Government Printing Office.

➤ EMISSION SPECTRA as a means of identifying the metallic elements and many non-metals as well are coming into greater use in analytical work. A reprint of an article describing this use by Paul T. Gilbert, Jr., of Beckman Instruments, Inc. is offered by the company. Write for Reprint R-56-266 to Beckman Instruments, Inc., South Pasadena 1, Calif.

➤ THYMIDINE, one of the key building blocks for formation of desoxyribonucleic acid, has been added to the list of hard-to-get cell chemicals offered for biological research by Schwarz Laboratories, Mt. Vernon, N. Y. For more information about how to get this compound, and its role in cancer research and studies of therapeutic agents and nutritional factors, write Paul F. Palace, Michel-Cather, Inc., 2 Park Avenue, New York 16, N. Y.

➤ EXTRACTORS for use with organic solvents by the Schmall method are offered in two forms, one for solvents lighter than water, the other for those heavier, by Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

➤ MYLAR, the new polyester film manufactured by Du Pont, is described in detail as to its dielectric

strength, insulation resistance, volume and surface resistivity, and similar properties in a bulletin which also suggests possible uses for the material. Du Pont is building a new plant to manufacture this product at Circleville, Ohio, which is expected to go into commercial production early in 1955. Lowering of prices for the various thicknesses of the film is promised as a result. To learn more about the material write for the technical bulletin on "Mylar" (#1-2-53) to the Du Pont Film Department's Sales Development and Technical Service Section, Wilmington 98, Delaware.

➤ PHOTOGRAPHIC plates designed for study of helium emission spectra are offered by the Eastman Kodak Co. The manufacturer gives the assurance that they are so infra-red sensitive that they will give the 200-inch Hale Telescope as much space-penetrating power as would have been equivalent to a hypothetical 900-incher only a year ago. A new sensitizing dye is responsible for this increased sensitivity. The products are known as Kodak Spectroscopic Plates and Films of Class Z sensitization.

➤ EASTMAN'S Organic Chemicals Department, Distillation Products Industries, Rochester 3, N. Y. announces ten new organic chemicals which they are ready to supply. The compounds are: Acrylamide MP 84-86°, MW 71.08 4-Amino-2,6-dimethylpyrimidine MP 184-186°, MW 123.16; 2,5-Dimethylfuran (Pract.) BP 89-93°, MW 96.12; 5,5-Dimethyl Hydantoin (Pract.) MP 176-178°, MW 128.13; 2,5-Diphenyloxazole MP 71-72°, MW 221.25; Formamide MP 2-3°, MW 45.04; Malonic Acid (Pract.) MP 136° dec., MW 104.06; Phthaloyl Chloride (Pract.) MP 7-10°, MW 203.03; Y-Valerolactone (Pract.) BP 84-86°/10 mm; m-Xylene (Pract.) (95 + %) MW 106.16.

➤ NUCLEAR Instrument and Chemical Corporation, 223 West Erie St., Chicago 10, Ill. has issued a new catalog featuring a guide to instrument selection. They state: "It is our desire to have our products in use where they are well matched to do the job. Therefore, wherever possible we suggest you give us a brief description of your projected work in advance of ordering, and allow us to recommend a suitable complement of instruments to solve your counting problems most efficiently."

➤ TRANSMISSION-TYPE interference filters are a feature of the new monochromatic colorimeter by Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y. For complete details write for Catalog D-245. Bausch & Lomb are this year celebrating the hundredth anniversary of the founding of their company.

➤ FLOTATION materials, particularly RADA (Rosin Amine D acetate) are described, suggestions are made for wider industrial uses for them, and mathematical formulas used in the operation and control of ore dressing mills are all included in the 1953 edition of Hercules Powder Co.'s booklet "Flotation." This is available from the company at Wilmington 99, Delaware.

➤ LINDANE and Aramite have been combined into one emulsion for control of spider mites in home gardens. It is packed in 8-oz. bottles, and gallon cans. It may be obtained from the Doggett-Pfeil Co., Manufacturing Chemists, Springfield 1, N. J. Nationwide distribution is being arranged.

Book Condensations

WATER SUPPLY AND PURIFICATION—W. A. Hardenbergh—*International Textbook Co.*, 3rd ed., 516 p., illus., $6.50. New materials and developments have necessitated rewriting a number of chapters. Included is a new chapter on fluoridation.

CHEMICAL INDUCTION OF CANCER—George Wolf—*Harvard University Press*, 250 p., illus., $3.50. Primarily concerned with the experimental induction of tumors in animals by chemical compounds.

THE LITERATURE ON STREPTOMYCIN: 1944-1952—Selman A. Waksman—*Rutgers University Press*, 2nd ed., 553 p., $5.00. Since the publication of the first edition less than four years ago, references dealing with this antibiotic have increased from 1,200 to almost 6,000. The new edition is largely devoted to the clinical uses of streptomycin.

ANNUAL REVIEW OF NUCLEAR SCIENCE—Vol. 2, James G. Beckerley, Martin D. Kamen and others—*Annual Review* (Stanford, Calif.), 429 p., illus., $6.00. Covering the most important developments in the field for the year that have been cleared with respect to security.

CHEMICAL ANALYSIS OF INDUSTRIAL SOLVENTS—Morris B. Jacobs and Leopold Scheflan—*Interscience*, 501 p., illus., $10.00. Covers the three major aspects of solvent analysis—the assay, the analysis of mixtures, and the identification of an unknown solvent or mixture of solvents.

PROGRESS IN THE CHEMISTRY OF FATS AND OTHER LIPIDS: Volume 1—R. T. Holman, W. O. Lundberg, and T. Malkin, Eds.—*Academic Press*, 186 p., illus., $7.00. The first of an annual series. Of interest to the specialist in this field, the chemist, the biochemist and the medical scientist.

CYTOCHEMISTRY: A Critical Approach—J. F. Danielli—*Wiley*, 139 p., illus., $4.00. The author explains that this is not a textbook (cytochemistry is so underdeveloped that a textbook would be premature) but it is a record of his own experiments and those of his associates.

THE THEORY OF ELECTRONS: And Its Applications to the Phenomena of Light and Radiant Heat—H. A. Lorentz—*Dover* (New York City), 2d ed., 343 p., paper $1.70, cloth $3.50. An unabridged student's edition of a long out of print classic originally published in 1906.

CELLULOSE: The Chemical That Grows—William Haynes—*Doubleday* 386 p., illus., $4.00. From the age of Marco Polo to the present, the history of this source material of rayon, paper, lacquer, plastics, etc. is traced in both fact and legend.

GLYCEROL—Carl S. Miner and N. N. Dalton, Eds.—*Reinhold*, 460 p., illus., $12.00. Contains complete information on the sources, recovery, refining and uses of this important chemical compound.

POLYSACCHARIDE CHEMISTRY—Roy L. Whistler and Charles L. Smart—*Academic Press*, 493 p., illus., $10.80. Outlines the present status of knowledge regarding the structure of natural high polymers of the carbohydrate type.